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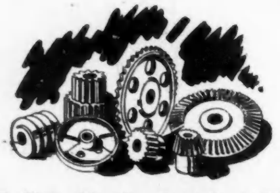

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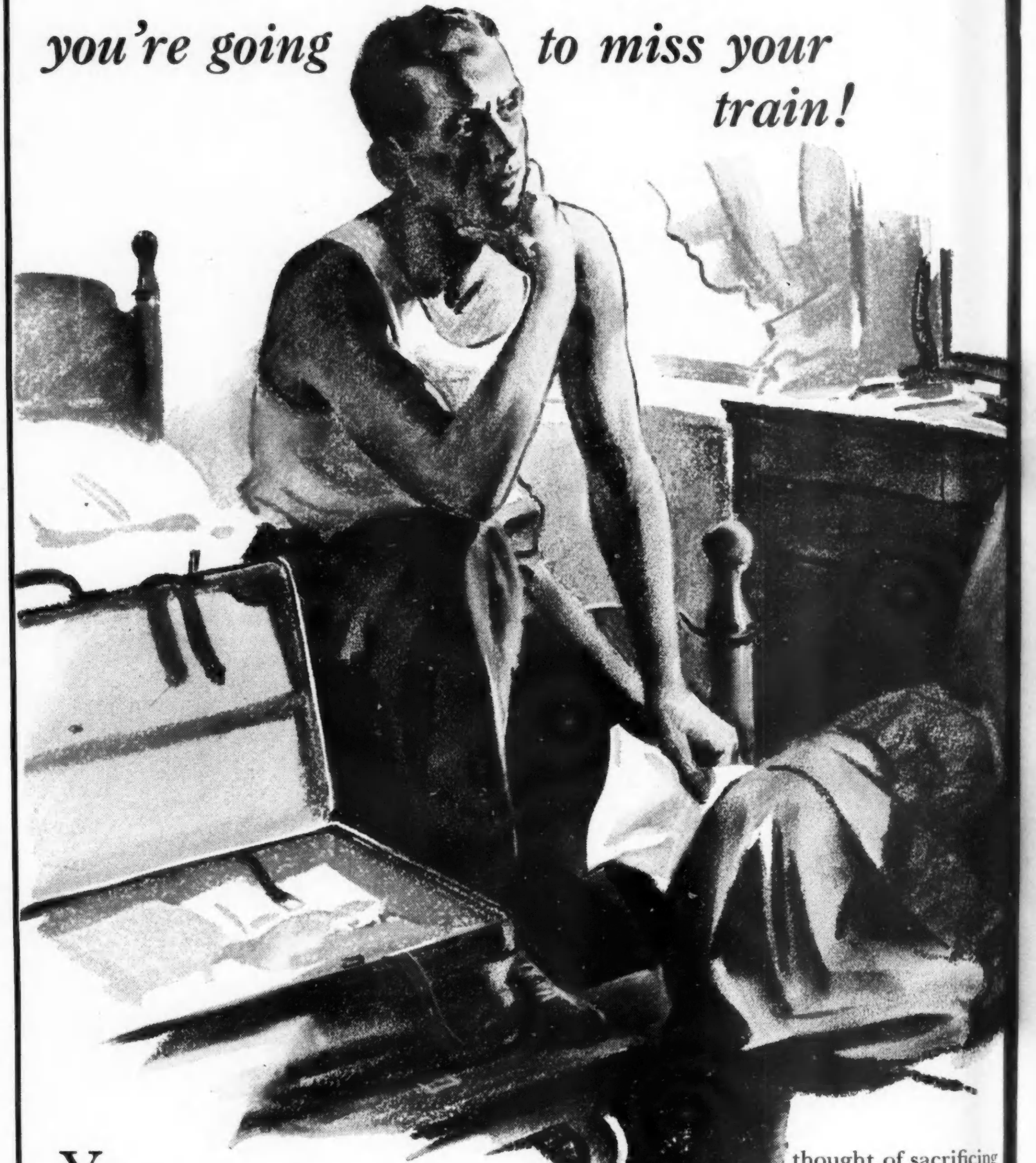

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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE
Reg. U. S. Pat. Off.
Published Weekly
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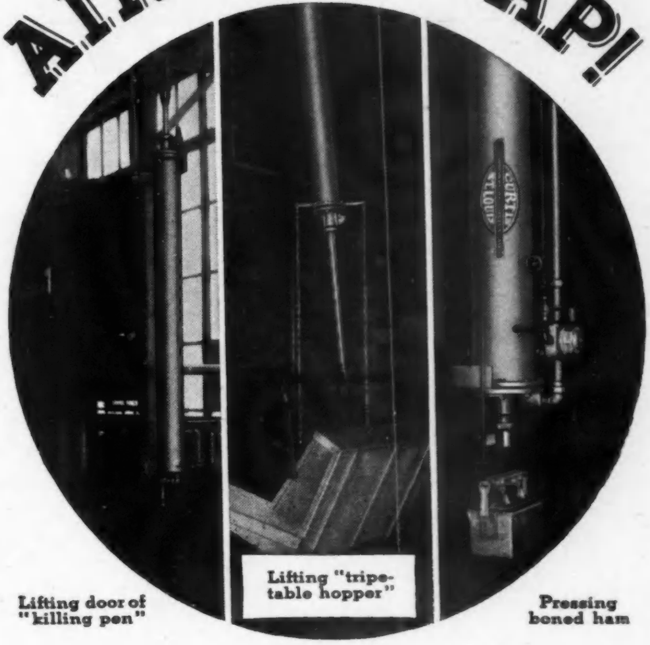

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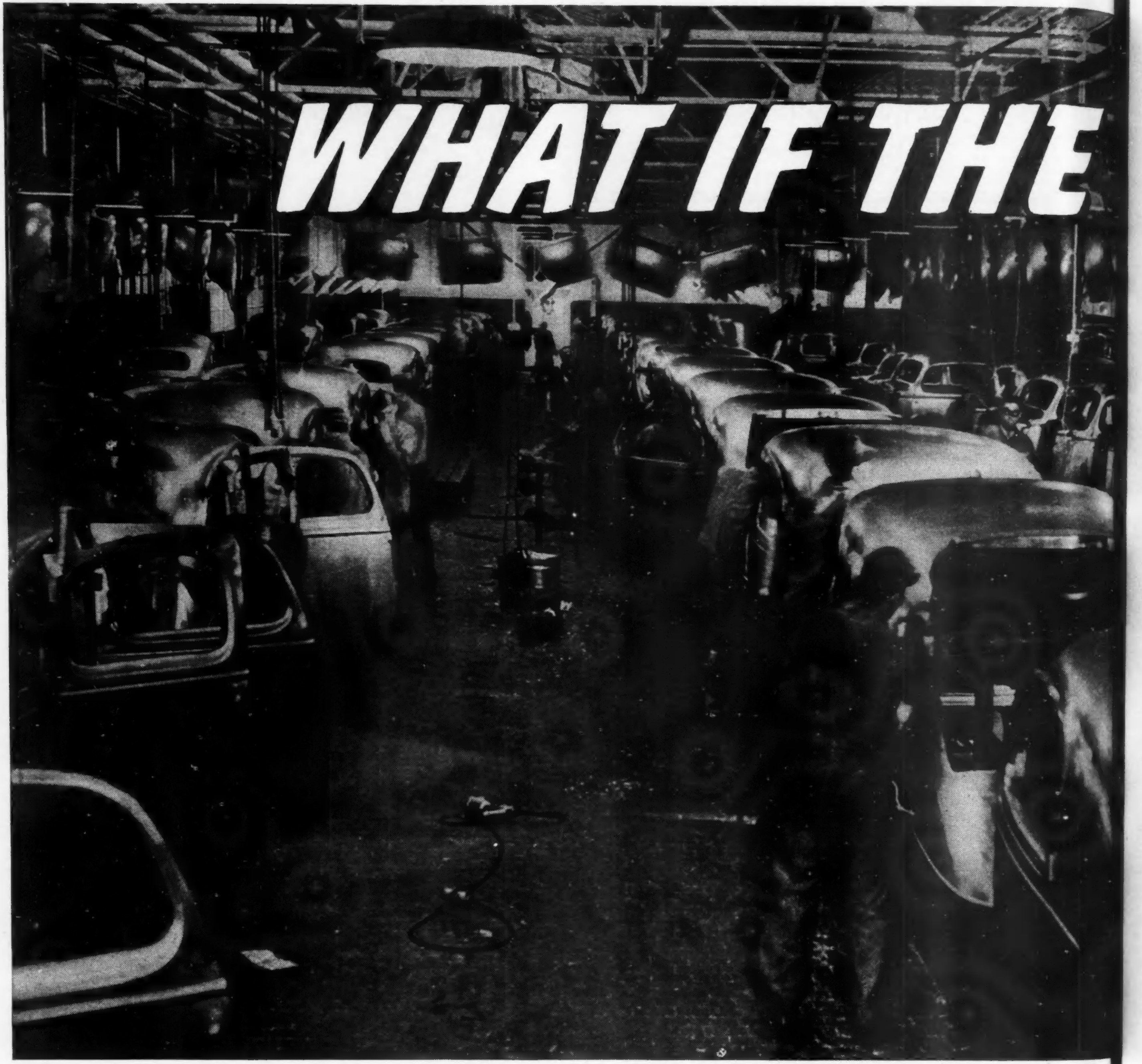

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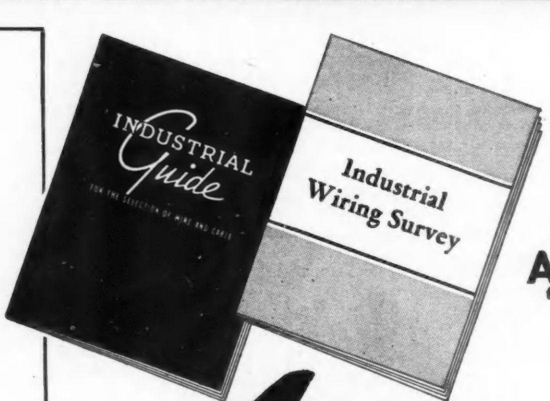
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AUTOMOTIVE INDUSTRIES

Published Weekly
Founded 1895

June 5, 1937
Vol. 76, No. 23

Car Output to Hold Well

Sales, Dependent on Field Stocks, Affected in May

As nearly as can be determined at this time, June production of the automobile industry will be on about the same level as in May. Some companies have cut schedules slightly, others have increased them. It appears now that the gains will about offset the losses. The principal curtailment is by the Ford Motor Co. which plans to drop four working days from the current month to stave off and shorten the normal summer layoff period. This will cut about 27,000 units from the June output, on the basis of the recent daily production rate.

May output of the industry did not come up to earlier expectations because of the many brief strikes that affected leading companies. Such stoppages interfered with General Motors plants, Plymouth and Studebaker during the past month. Moreover, the extension of the holiday weekend by the Ford Motor Co., whose plants were for the most part closed on Friday last week, further cut down the anticipated May output. Ten plants for which figures are available, missed their original May schedules by a total of 43,000 units.

The final May output figure for the industry is almost certain to fall below that of April's 553,415 units, and will probably do well to hit 540,000. The latter figure is the indicated production for June on basis of schedules that have been established. Thus, as it looks now, the second quarter output will fall somewhere in the neighborhood of 1,635,000 cars and trucks which compares with 1,477,652 units built in

(Turn to page 851, please)

HOFFMAN As president of the Automotive Safety Foundation, Studebaker's president will be able to direct on an adequate scale a work dear to his heart since he was California dealer.

Safety Foundation Formed

Car, Truck, Parts, Tire and Finance Companies Cooperate in Setting Up New Permanent Body to Carry On Program

The motor vehicle industry's drive for a greater measure of highway safety was placed on a solid and permanent foundation when, at a dinner in Detroit, June 2, high executives of leading companies in the automobile, truck, parts and tire manufacturing fields, and in the financing group, completed the organization of the Automotive Safety Foundation, Inc.

The move was made in an effort to correlate safety efforts and provide a new starting point for a continuing and consistent plan in that direction. Indication of the scope of the work to be carried on was given in the comment of Alvan Macauley, president of the Automobile Manufacturers Association and of the Packard Motor Car Co., at the dinner, that the industry will spend nearly $500,000 on the 1937 program. This, he pointed out, is in addition to the large sums spent by individual companies in providing safety literature, films and other materials. He commented that of equal significance is the cooperative support extended by the industry for uniform traffic legislation by states and municipalities.

A seven-point program developed over the past year will form the basis of the foundation's activities, embracing: (1) education; (2) traffic control

(Turn to page 829, please)

This Week

NEWS includes details of the formation of the Automotive Safety Foundation . . . Latest developments in the labor situation . . . Behind-the-scenes report of what happened at Indianapolis . . . June production plans of the industry.

FEATURES include statistics from, and interpretation of, 1936 car and truck company financial statements . . . Borg & Beck and Federal Motor Truck production stories.

Man-Hour Studies

Pioneered by L. P. Alford, Affected Industry

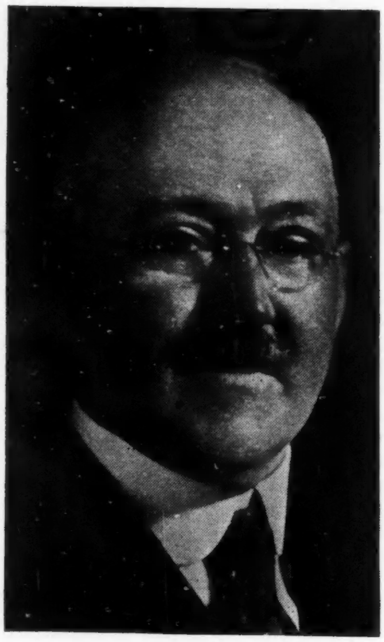
L. P. Alford, originator with J. E. Hannum of a method of rating the effectiveness of management on a 1000-man-hour basis, has been named professor of administrative engineering at New York University.

Dr. Alford's method has been applied to many industries, but found governmental recognition and application in the preparation of the Henderson report on the regularization of employment and the improvement of labor conditions in the automobile industry. The report was made as part of the industrial studies under the NRA and was published in January, 1935.

The original report of the 1000-man-hours basis for rating plant managements (see AUTOMOTIVE INDUSTRIES, April 6, 1929) presented a table which showed that company "A," unnamed, was producing 1.22 cars per 1000 man-hours, company "B" 1.83 cars, and upward to company "L," which produced 36.40 cars per 1000 man-hours. Company "K," with the largest production, secured 19.70 cars per 1000 man-hours. Unit production of company "A" was 3355 cars, that of company "B" was 8801 cars, that of company "K" was 2,090,959 cars, and that of company "L" was 59,074 cars. Presumably, although no mention was made of it, truck production was included as part of production. The general average was 9.08 cars per 1000 man-hours.

In addition to production per 1000 man-hours of work, the method also was applied to manufacturing and net profit, investment in buildings and number of square feet, investment in machinery, horsepower utilized, number of workers employed, number of lost-time accidents, number of working hours lost in such accidents, various cost breakdowns and selling prices, all rated in the same way.

The authors of the method believed that it was possible to compare either two businesses, where figures could be secured, or the relative efficiency of plants within a business, or the operation of a business for different periods. They pointed out that to compare two businesses, it would be obviously necessary to take two in the same general kind of operation.



L. P. ALFORD

. . . his 1929 studies were reflected in the Henderson report of 1935. He has just been named professor of administration at N. Y. U.

1902 Stanley Steamer
D

IN 35 YEARS the business of insuring automobiles has acquired a more than middle-aged spread. Net premiums paid for fire and theft protection on U. S. and Canadian cars in 1936 reached $192.5 million; losses paid took $75.3 million.

Bendix Steering Control

A new steering device recently developed to counteract steering shocks resulting from blowouts or unexpected obstacles in the road will soon be manufactured and put on the market by the Bendix Products Corp. Demonstration of the new steering control device, known as the "hydraulic hand" was made before the 500 distributors of Bendix Products, by Andrew Ross, a test driver, of Pittsburgh. He deliberately held his hands high in air with automobile traveling 60 miles an hour while his companion in the front seat fired a shotgun, blowing out a right front tire. Through the hydraulic action of the new mechanism, which may be attached quickly between the tie rod and front axle of any passenger car, truck or bus, the car is held steady despite the shock of the blown front tire until the driver has time to lower his hands and apply the brakes.

Mallory Buys Electrad

P. R. Mallory & Co., Inc., Indianapolis, announce the purchase of the assets, good will, trade-marks, patents and patent rights of Electrad, Inc., New York City. L. A. de Rosa, chief engineer, and other key employes of Electrad, Inc., will join the Mallory organization. Plant and offices will be moved to Indianapolis.

Was Car a Boat in 1902?

Policy on Stanley Steamer Raised Boston Problem

One June 2, 1902, ship-owner Ralph C. Emery called at the offices of the Boston Insurance Company and made a puzzling request, puzzling, because there was no precedent. The request was not, as usual, for insurance on a ship or a cargo.

"I have bought a Stanley Steamer automobile," he announced calmly, "and would greatly appreciate your insuring it against the risk of fire."

The word "automobile" did not then appear in any statutes, and there was no specific authorization for automobile insurance, but a broad construction of the existing laws by a liberal-minded Massachusetts attorney general ruled insurance on automobiles to be marine insurance. This decision was accepted by the insurance departments of other states. The theory was that if the insuring of goods on board railroad cars was marine insurance, then the insuring of a motor running on wheels of its own, instead of on wheels of a railroad car, was really marine insurance.

The policy written by the Boston Insurance Company read: "$950 on a two-seated, Surrey style, single cylinder, French Pattern; $50 on Tools, Implements and Personal Effects, for one year from June 2nd, 1902, at noon as per form attached."

The primary cover wanted was the fire risk only, which was provided, and then there was added to this cover protection against the perils of fire and derailment of cars while the automobile was on board railroad cars, and against damage caused by stranding, sinking, burning or collision of the steamer when the automobile was on board a steamship. The form was attached to the schooner form of policy.

> "In the earlier stages of automobiling when cars were restricted to the use of the rich and for pleasure only, they were insured, no doubt, against loss by fire under the regular fire policies of the companies and in the same manner as other property; but the need for broader protection was soon evident, and early in 1902 the Boston Insurance Company of Boston offered a contract to the automobile owners which insured them against the hazards of fire, transportation and theft, shortly followed by a reformation of the policy to include the hazard of collision, and it is of interest to note that, while this company was the pioneer in this form of insurance, except for a few earlier contracts written at Lloyds, London, their form of cover and the rate charged are substantially the same today as they were in the infancy of the business. Some time elapsed before any other company took up this form of insurance, though the Boston was followed later on by practically all the marine companies doing business in the United States."
> From "The Business of Insurance," by HOWARD B. DUNHAM.

Buick Service Active

Buick dealers did a total business of $65,149,000 in service, parts and accessories in 1936, against $50,776,000 in 1935 and thus far this year have been running 25 per cent ahead of the 1936 rate, reported C. W. Jacobs, parts and service manager.

April Registrations Dip

New passenger car registrations for April amounted to approximately 386,700 as compared with 397,190 during April, 1936, according to an estimate based on returns from 46 states and the District of Columbia. The decrease of slightly over two per cent from April, 1936, can in the main be attributed to the various strikes throughout the industry especially that of the Chrysler Corporation.

Based on this estimate for April, new registrations for the first four months of the year amounted to 1,245,855 an increase of 14 per cent over the 1,090,912 new registrations during the same period of 1936.

Rohde Dies of Injuries

Champion's Chief Engineer Hurt at Indianapolis

Otto C. Rohde, 49, vice-president and chief engineer of the Champion Spark Plug Co. who was struck by the racing car of Overton Phillips, Middletown, N. Y., when it crashed into pits at Indianapolis last Friday, died June 3 in City Hospital in Indianapolis. He had suffered a fractured skull and other injuries. Pneumonia complicated his injuries.

Rohde had attended every 500-mile race at Indianapolis in his 22 years' service with the Champion Spark Plug Co. He was a graduate of University of Michigan and chairman of the ignition division of the Society of Automotive Engineers.

He leaves his widow and a daughter. He was second victim of the accident.

Renault Enters Japan

Showa-Renault of Tokio will later this year begin the manufacture of some parts of Renault automobiles but will continue to import engines and transmission units. The company is awaiting the arrival of four Renault engineers. Actual operation under the Renault patents will begin in 1939.

A first shipment of Renault products, including passenger cars, trucks and buses, with gasoline and diesel power, will reach Japan next month. Showa-Renault plans to offer them at very low prices, underselling Ford and Chevrolet sedans. In order to handle both selling and the projected manufacturing operations, Showa-Renault will increase its capital.

Goodyear Offers New Tire

The Goodyear Tire & Rubber Co. will place on the market during the week beginning June 7 a new first quality passenger car tire, designed for safety. It will be known as "R-1" and will be offered at no advance in price. The tire is said to have a wider, flatter tread with 12 per cent more rubber in the tread, higher and broader shoulders and "streamlined" sidewalls.

Ford Labor Held Against UAW

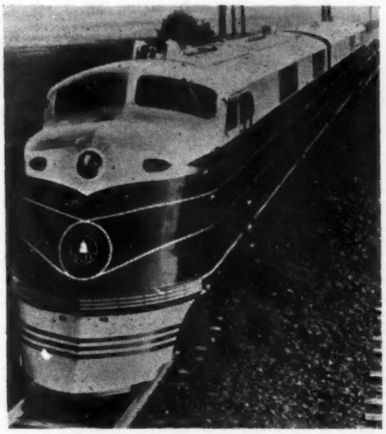
Bennett Claims 60,000 Loyal; Fight Probes Proceed Only Slowly; Union Prepares New Moves

A vast majority of Ford employes are behind the company in its struggle to escape the shackles of unionism, according to Harry Bennett, Ford personnel director, who claims that approximately 60,000 of the 89,300 workers at the Rouge plant have turned in unsolicited pledges of loyalty. "Stand pat against the union" many of the workers advised, he said.

Meanwhile union leaders reported that the two UAW branches established in the vicinity of the Ford plants were signing up Ford workers at the rate of more than one a minute. Their supply of UAW buttons had been exhausted for the time being and only membership cards were being issued to new members.

Investigators were making slow progress in their efforts to fix responsibility for the May 26 riot at the Ford plants which interrupted the distribution of union hand bills and sent nearly a score of union representatives home badly bruised as a result of their encounter with Ford workers. While Harry Bennett insists that none of his "service men" were involved in the fracas, Homer Martin claims the union has identified service men in pictures of attacks on Richard T. Frankensteen, UAW organizational director.

A Common Pleas Court grand jury started an investigation on June 2 of the fight. The inquiry was opened at the request of Wayne County prosecutor Duncan McCrea. Among the witnesses subpoenaed were Mayor John L. Carey of Dearborn and his police chief Carl A. Brooks, Harry Bennett, Ford personnel chief, and a member of his staff.



ACME

LAST LINK in diesel operation between Atlantic and Pacific, that from Chicago to Washington, via B & O, will be closed by this new EMC 3600 hp. streamlined engine, and its twin. They will haul the Capitol Limited. Electro-Motive Corp., the manufacturer, is again increasing its production facilities.

The fight occurred on one of the bridges leading from the factory over a highway to the trolley car terminal which is on Ford property. Because of this arrangement, the union is having trouble getting to the workers going on and off shifts without entering Ford property. An engineering crew of the County Road Commission is engaged in reestablishing the boundary line between Ford property and the public highway, the action being taken at the request of Dearborn's city engineer.

While no date has been set, union leaders are planning another attempt to distribute union literature to Ford workers at the plants although it is quite probable they will avoid trespassing on Ford property in their next attempt. Harry Bennett said the UAW might distribute all the literature it wants to so long as it remains off Ford property.

The union has been granted a year's license for distribution of leaflets in Dearborn with the understanding that the city clerk approves the text of any literature handed out.

Charges of discrimination were filed with the NLRB by a committee of union men from the Ford Sommerville, Mass., branch. According to the union, about 100 of its members had been discharged from this plant but Bennett explained that the men were not discharged but laid off because of seasonal curtailment of production. He said that about 200 employes had been laid off for this reason and that it was the company's policy to take them back as soon as possible.

A subpoena has been issued for Edsel Ford summoning him before the one-man grand jury investigating last week's fight between Ford workers and UAW organizers. Process servers have been unable to serve the subpoena on Harry Bennett.

Claiming a majority of the workers in the Ford plant at Richmond, Cal., closed by a UAW strike recently, the International Association of Machinists, an American Federation of Labor Affiliate, has filed a petition with the NLRB asking for an election to determine which union shall represent the workers in collective bargaining.

That the AFL is planning to compete aggressively with the CIO in the automotive field was indicated by F. J. Dillon, Federation organizer, who said that plans were being formulated to issue charters to anyone.

UAW to Decide on GM Moves

What the UAW intends to do about its contract with General Motors Corp., which expires Aug. 11, will be decided this week-end at a meeting of dele-

(*Continued on page 830*)

Workers Hear Plant Programs

Borg & Beck Installs Radio Speaker System for Them

Desire to give plant employes current sports and other information and some musical relaxation during working or lunch hours, plus the need for a paging system whereby visitors or executives could be reached, was the reason for the installation of an RCA public announcing system in the Borg & Beck division of the Borg-Warner Corp. Initial results have been highly satisfactory, with one phase of the entertainment the broadcasting of musical programs produced entirely by employe talent.

The announcing system consists of a radio receiver, a phonograph record reproducer, microphone, power amplifier and fourteen large dynamic horn type amplifiers.

It is the view of the management that the cost of the installation has already been justified by its utility and by the improvement in employe relationships with the management and between the several departments. The announcing system has never been used for "propaganda" purposes, states the management. The only purposes to which it will be put is to meet the employes' desire for news and music.

RELAXATION is provided for plant workers of Borg & Beck who receive musical programs given by their fellows, and sports on this announcing system.

Surprising to the company, and to the employes was the success of the employe musical programs. An immediate result of the discovery of a number of good voices was the formation of a glee club which has been functioning for over a year. Program director for both is Gwyllm Jones, an employe in the assembly department who was widely known in England and Wales as a baritone. Mr. Jones has also had several years' experience in radio broadcasting here. The daily musical programs are directed by Mrs. Etta Mielke, telephone operator at the plant. Her's also is the task of operating the radio and phonograph apparatus.

Gains Presaged in 1936 Reports

Motor Vehicle Companies Carried Larger Inventories, Showed Strong Financial Position at Year's End

Complete details will be found on pages 846, 847 and 848.

Preparations for a big automotive year in 1937 were clearly shown in the financial statements of nineteen automobile and truck manufacturing companies dated Dec. 31, 1936. A very large majority of the reporting companies showed substantial increases in inventories, while about half the concerns reported increases in plant and property accounts, shown net after depreciation reserves.

There could have been, of course, several reasons for the enlargement of inventories. These would include ordinary stocking up in anticipation of larger manufacturing operations early in 1937, buying of materials before expected price increases, and purchases in efforts to offset the effects of possible labor troubles at suppliers' factories. It is probable that all three entered into the situation, but it is also certain that the automobile and truck companies would not have added to inventories if they had not been certain of their ability to use the materials.

Since most inventories are carried in balance sheets at the lower of cost or market, it can be fairly assumed that the larger inventory valuations shown meant larger physical volumes. This would not have been so much the case if inventories were carried at market, because year end prices were higher than the prices which obtained earlier when some of the inventory materials were acquired.

Property accounts, net after depreciation reserves, were less conclusively higher for 1936 than for 1935, but in some cases reflected the installation of new machinery, and in other cases the construction of additional branch plants and parts storage depots. These fixed assets were far lower than in 1929. The accounts still reflect the depression-born trend toward writing down properties in order to secure lower depreciation charges, and so, to improve net earnings figures. Property accounts of the two largest companies included showed positive gains, but in other cases there was a notable lack of trend. Probably, this is traceable to the fact that the two largest producers do a larger percentage of the total business than they did up to the depression years.

Only a moderate increase in most-liquid-assets took place in 1936. This was due to the absorption of cash for inventory enlargement, to the payment of year end dividends as the means of avoiding surtaxes on undistributed earnings, and in some cases, to debt reduction. Earnings, of course, were larger last year than in 1935, and it would have been normal to expect greatly increased cash positions, even with inventory-building going on. In a number of cases where there are available directly comparable statistics, a far larger portion of earnings was shown to have been paid out in dividends in 1936 than in 1935. Tax experts differ in their analysis of the law that lays penalty taxes on companies which fail to pay out earnings as dividends, but many say that the tax schedule is less burdensome if at least two-thirds of net income is paid in dividends. The tax scales upward as more of net income is retained.

Still, only nine out of 19 companies included in the survey paid dividends in 1936, although there were but three companies reporting losses out of 16 which reported the year's results. In some cases, this was due to the difference between reports to stockholders on the one hand, and income tax returns, which often are different.

There was in 1936 a marked tendency for current liabilities to increase. In large measure, this can be attributed to higher tax liabilities, and, of course, to accumulated payrolls at the higher rates for the larger number of men on

(*Turn to page 848 please*)

The Box Score

Following is a tabulation of the results for the year 1936 showing the number of companies **to report gains and declines in several categories:

	Gains	Declines
Net Income	13	3
Dividends	6	1
Cash and Securities	10	6
Inventories	14	2
Total Current Assets	14	2
Total Current Liabilities	12	4
Net Working Capital	11	5
Property After Depreciation	9	4
Surplus*	12	5

*Includes capital and earned surplus.

**Records on some companies are incomplete and therefore the gain and loss totals do not in all cases reach 19, the number of companies appearing in the survey in some form.

Safety Foundation Formed

(*Continued from page 825*)

administration; (3) legislation; (4) enforcement; (5) engineering; (6) technical personnel training, and (7) research.

Specifically, the foundation seeks adequate accident reporting and analysis, the training and employment of technical specialists in traffic engineering and police control, modernization of present roads and streets and the highest type of new construction consistent with available funds, raised levels of driving performance and pedestrian education and dissemination of information pertaining to the safe and efficient use of motor vehicles.

"Effective control of traffic and accidents will not be achieved until government—Federal, state and local—fully recognizes its responsibility by exercising the authority it now has to deal with the problem," said Paul G. Hoffman, president of the foundation and president of the Studebaker Corporation. "Every state can have as much or as little safety as its citizens insist upon getting. Each state and municipality should have an official state safety organization, financed by state funds, to correlate the engineering, enforcement and educational activities of governmental departments, and to enlist public support. To the achievement of this objective the Automotive Safety Foundation pledges its utmost support."

NORMAN DAMON

. . . as secretary of the Safety Traffic Committee of the Automobile Manufacturers Assn. he has worked unremittingly for practical advances in safety on the highway. His work was recognized this week by his appointment as a director of the Automotive Safety Foundation.

Officers of the foundation are: president, Paul G. Hoffman, president Studebaker Corporation; vice-president, F. B. Davis, Jr., president United States Rubber Company; vice-president, C. C. Carlton, president Automotive Parts & Equipment Manufacturers; vice-president, A. O. Dietz, president Commercial Investment Trust; treasurer, Byron C. Foy, president DeSoto Motor Corporation; assistant treasurer, Alfred Reeves, vice-president and general manager, Automobile Manufacturers Association, and director, Norman Damon, manager safety department, Automobile Manufacturers Association.

Trustees in addition to the officers, are:

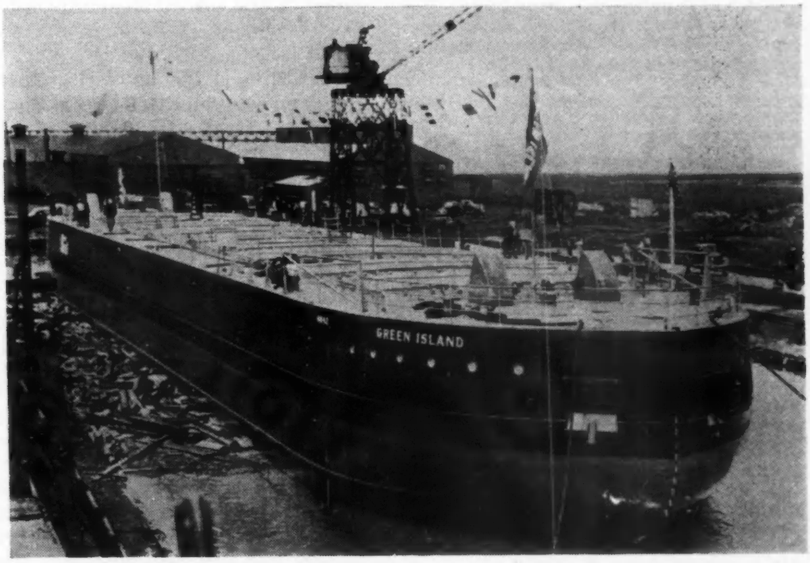
A. E. Barit, president, Hudson Motor Car Co.
R. F. Black, president, The White Motor Co.
Donaldson Brown, vice-president, General Motors Corp.
Walter P. Chrysler, chairman, Chrysler Corp.
J. E. Fields, vice-president, Chrysler Corp.
E. C. Fink, president, Mack Bros. Motor Car Co.
R. H. Grant, vice-president, General Motors Corp.
Robert C. Graham, vice-president, Graham-Paige Motors Corp.
B. E. Hutchinson, vice-president, Chrysler Corp.
K. T. Keller, president, Chrysler Corp.
Wm. S. Knudsen, president, General Motors Corp.
Alvan Macauley, president, Packard Motor Car Co.
W. F. McAfee, manager, domestic sales, International Harvester Co.
Charles W. Nash, chairman, Nash-Kelvinator Corp.
Alfred P. Sloan, Jr., chairman, General Motors Corp.
Vincent Bendix, president, Bendix Aviation Corp.
C. C. Bradford, president, Eaton Products, Inc.
C. S. Davis, president, Borg-Warner Corp.
E. F. Deacon, president, Climax Engineering Co.
M. C. Dewitt, vice-president, Champion Spark Plug Co.
B. F. Hopkins, president, Cleveland Graphite Bronze Co.
D. H. Kelly, vice-president, Electric Auto-Lite Co.
J. E. Otis, Jr., president, Stewart-Warner Corp.
D. W. Rodger, vice-president, Federal-Mogul Corp.
J. Y. Scott, executive vice-president, Van Norman Machine Tool Co.
Lothair Teetor, vice-president, Perfect Circle Co.
Hugh H. C. Weed, vice-president, Carter Carburetor Corp.
C. E. Wilson, vice-president, General Motors Corp.
J. D. Biggers, president, Libbey-Owens-Ford Glass Co.
Walter O. Briggs, chairman, Briggs Manufacturing Co.
H. S. Wherrett, president, Pittsburgh Plate Glass Co.
J. J. Schumann, Jr., president, General Motors Acceptance Corp.
H. L. Wynegar, president, Commercial Credit Corp.
Harvey Firestone, chairman, Firestone Tire & Rubber Co.
P. W. Litchfield, president, Goodyear Tire & Rubber Co.
S. B. Robertson, president, B. F. Goodrich Co.

Yesterday's Hope; Today's Fact

More than a year ago, in our issue of March 28, 1936 (page 473) we editorialized as follows: "It is still our hope . . . that out of the present welter of thinking on the subject [of safety] there will emerge a plan for highway safety education on a national basis, taking into account the peculiar requirements of the various groups to be educated, and providing for consistent effort to see that these groups are reached with the necessary implements for their education.

" . . . Coldly faced, we believe no plan yet offered provides a complete answer."

Without in any way claiming credit for the idea, we are delighted to see in the Automotive Safety Foundation, an apparent fruition of our earnestly expressed hope.



Acme

WELDED motorship is launched for the Ford Motor Co. Another is to be put into the water on June 5. The boats will be commissioned June 20 and July 20. They are the first all-welded ships constructed on the Great Lakes and are intended for Detroit to the Atlantic Coast use. The Ford fleet of 31 freight-carrying ships totals 130,950 tons. Its two lake ships, the Benson Ford and Henry Ford, are the largest motor ships on the Great Lakes. The two new boats, Green Island and Norfolk, are 2200 ton ships and are powered by two 600 hp. diesel engines each. They have disappearing superstructures to permit canal passage.

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for AUTOMOTIVE INDUSTRIES

There were several indications that the upward movement of general business continued last week, although unsettlement existed in some quarters because of renewed strike activity. The weekly index of business activity compiled by the "Journal of Commerce" stood at 105.5, as compared with 105.1 the week before and 92.1 a year ago. The Guaranty Trust Company's index of business activity for April stands at the preliminary figure of 95.4, as compared with 99.3 the month before and 82.9 for the corresponding period last year. The company's index of wholesale commodity prices on May 15 was 87.0, as compared with 88.6 a month earlier and 67.5 a year earlier.

Wholesale Prices Ease

Professor Fisher's index of wholesale commodity prices for the week ended May 29 was 93.3, as against 93.5 the week before and 92.7 two weeks before.

The consolidated statement of the Federal Reserve banks for the week ended May 26 showed increases of $1,000,000 in holdings of discounted bills and of $2,000,000 in bills bought in the open market. Holdings of Government securities remained unchanged. Money in circulation was unchanged, and the monetary gold stock increased $70,000,000.

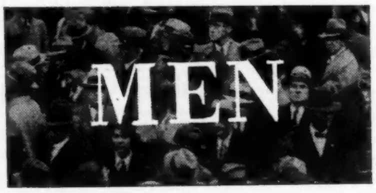
Several Indices Rise

Railway freight loadings during the week ended May 22 totaled 779,276 cars, which marks a gain of 5607 cars above those in the preceding week, a rise of 95,686 cars above those a year ago, and an increase of 180,880 cars above those two years ago.

Production of electricity by the electric light and power industry in the United States during the week ended May 22 was 12.1 per cent above that in the corresponding period last year.

Further gains were reported by the Bureau of Labor Statistics in payrolls and employment in manufacturing and non-manufacturing industries during April. During that month 98,000 additional workers found employment in those industries, and aggregate weekly payrolls rose by $8,200,000.

Lumber production during the week ended May 14 was 80 per cent of the 1929 weekly average. New orders were at the lowest level since early March and were slightly below those in the corresponding period last year. Shipments were slightly above the level in the preceding week but were slightly lower than those reported in any of the five weeks preceding.



MEN

JULIUS P. HEIL, president and treasurer of The Heil Co., Milwaukee, manufacturing motor truck bodies, hoists, and a variety of other equipment, has been elected president of the Jambor Tool & Stamping Co., Milwaukee, maker of automobile replacement parts, such as mufflers and other stamped sheet steel parts.

R. R. ZABRISKIE, for several years Western sales manager of Doehler Die Casting Co., has been named vice-president.

H. A. TODD, associated with the First Wisconsin National Bank of Milwaukee, for 17 years, has been elected president of the Wisconsin Motor Corp., pioneer Milwaukee manufacturer of gasoline engines for passenger cars, trucks, buses, etc.

JAMES J. NEWMAN, for the past four years a vice-president of The B. F. Goodrich Company, has been named vice-president and general manager of the company's tire division, it is announced by President S. B. Robertson.

HARTE COOKE, mechanical engineer, with McIntosh & Seymour Corp., has been nominated as a vice-president of the American Society of Mechanical Engineers to serve two years. Letter ballots for the election will close Sept. 28.

G. L. MOYERS has become president and general manager of Diesel Motors, Inc., a company formed to distribute and service diesel-engined equipment in Detroit and Michigan. He was for nine years director of sales for the Handy Governor Corp.

DONALD H. SPICER has been appointed assistant manager of the replacement sales division, Asbestos Manufacturing Co.

Ford Labor Said Against UAW

(*Continued from page 827*)

gates from GM locals to be held at union headquarters in Detroit, June 5 and 6. The contract provides for 60 days' notice if either party desires to make a change or terminate the agreement, which makes June 11 the latest date such request can be made. Among other things, the union is expected to demand sole collective bargaining rights, although it is still a question whether the union dares risk an election to prove their claim under the Wagner Act.

Unauthorized strikes continue to harrass GM plants. There have been 80 interruptions since the union agreement was signed.

The Chevrolet foundry and service parts plant in Saginaw resumed operations June 3 after Ed Hall, vice president of the UAW, succeeded in persuading the workers to abandon their unauthorized strike. Negotiations were to be started on wage adjustments. Chevrolet motor plants in Flint had to close the same day due to a shortage of the castings supplied by the foundry.

The McCord Radiator Co. plant in Detroit was closed by what started out to be a sitdown strike Friday morning of last week. The temptation of a long holiday week-end ahead, however, proved too much for the stay-ins who decided to evacuate before nightfall. The plant is still closed.

The Goodyear Tire & Rubber Co. plant No. 1 at Akron closed June 3 and threw 5000 men out of work following new sitdown strikes in four departments. Dissatisfaction with wages and working conditions were cited by the men.

A brief sitdown demonstration interrupted production in the small car division of Packard Motor Car Co. last Wednesday morning. About 175 workers were involved and the trouble was ironed out in less than three hours. Strikers objected to working under certain foremen.

In Pontiac, Mich., the UAW was behind a strike of renters. Some 15,000 tenants were planning to hold up all payments to landlords until their rents were reduced. Mayor Backus of Pontiac, himself a property owner and real estate man, said that rents seemed high only in comparison with the distress rentals owners were willing to accept during the depression. The union makes no protest against the rentals charged by General Motors Corp. which during the years of Pontiac's industrial expansion had built 700 homes to relieve the housing shortage.

Faced with choosing the appropriate unit for collective bargaining, the National Labor Relations Board as decided in favor of the Local No. 12 United Automobile Workers of America, Committee for Industrial Organization and against Local No. 4, Mechanics Educational Society of America, a craft union, for a secret election which the board has ordered to be held within 15 days among the 400 production employes of the Acklin Stamping Co., Lucas County, Ohio. Consequently, balloting will be on a plant-wide basis.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

"On Motor Traffic,"

A paper by Sir David Salomons,
President of the Self-Propelled Traffic
Association (England)

Personally, I do not view with the utmost favor the pneumatic tire, on account of its mechanical disadvantages. Indeed, if the springs of a carriage are sufficiently well made and adjusted, a circumstance rarely to be found, the advantage of the pneumatic is almost absent, and I believe that for motor traffic the steel or solid rubber tire will prove to be the favorite in the long run, when sufficent attention is given to carriage springs . . . On bad roads an advantage may be gained, but on good ones the steel tire carries the palm . . . It is found that the rubber of the pneumatic tire will burn if the load is very heavy. Whether this is due to the successive compressions of the air when meeting obstructions on the road, or whether it is owing to the friction of the air in the tube, due to lag in having to pass through a very restricted opening in a portion of a tube, *i. e.*, that part which is in contact with the road, and to friction generally, it is difficult to say . . .

From *The Horseless Age*, June, 1897.

Automotive Metal Markets

Users of Flat Steel Products Not Yet Inconvenienced by Labor Troubles; Ingot Capacity Questioned

Developments over the holiday made for a feeling of more or less uneasiness in both ferrous and non-ferrous divisions of the metal market.

Eruptions on the labor front in some of the "independent" steel plants, while for the moment inconveniencing consumers but little, served to make the long range price outlook more hazy. Steel company officials express confidence that they will be able to minimize the untoward effect on output of these interruptions. So far there has been no need of consumers shifting their sources of supply to any appreciable extent. As is always the case under such conditions, what might happen comes in for more attention than what is actually happening.

Of considerable interest to steel consumers was one of the keynote speeches at the American Iron & Steel Institute meeting, in which a leader of the industry took a decided stand against any important increase in steel making capacity, although he advocated the development of new finishing processes and efforts to make better and more products. Not long ago, scarcity in the supply of primary steel was held responsible for the tight fit between demand and supply of the finished flat steel products, so extensively used in automobile manufacturing. Since then some steel producers have announced a program of expanding their furnace capacity. The benefit which the automotive consumer derives from increased rolling and finishing capacity would be jeopardized, were primary steel capacity to fail to keep pace with it. Some market observers see a further addition to steel making costs, if not to steel selling prices, in the maximum hour legislation now being agitated. The average working week in the steel industry now is reported to be 42.4 hours.

The American Iron & Steel Institute's estimate of the rate of operations in steel mills this week is 77.4 per cent of capacity, compared with 91 per cent in the preceding week. In part the recession is due to the strikes in some of the "independents'" plants, but a natural let-down, following two months of operating rates at around 90 per cent, is seen to have set in.

Prices on the London Metal Exchange gave way on Monday, in line with the bearish interpretation put on the Spanish imbroglio by London's financial community. Sentiment on Tuesday turned a shade more cheerful. Prices here were quotably but little affected, but the tone of all non-ferrous metal markets was decidedly easier.

Pig Iron—Shipments into automotive consumption continue heavy, but resumption of fresh buying is still in abeyance.

Aluminum—Resumption of work in one of the plants in the Detroit area, where workers had been on strike, is the only important development. Piston metal is in good demand. Prices are unchanged.

Copper—With export prices fractionally again lower (the quotation on Tuesday was 14.30 cents), fear of a nearby advance in the domestic price has been removed. The market for electrolytic is unchanged at 14 cents.

Tin—Although London and Singapore prices yielded ground on Monday, the market here opened a fraction higher than at the close of last week. Tuesday's quotation for spot Straits was 56⅛ cents.

Lead—Storage battery makers are actively covering their July requirements. The market is steady and unchanged.

Zinc—Firm and unchanged.

:SLANTS:

STRATEGY—*Free rides in a fleet of private automobiles to keep paying passengers off a struck bus line was the strategy employed by CIO's Transport Workers Union in the Bronx, New York. The union's legal staff quickly arranged matters with the local police who issued a few summonses for operating carriers without proper licenses.*

SOFTBALL—*Lansing, Mich., has a unique situation in its recreation program. For years, Oldsmobile, Fisher Body and other automotive plants have sponsored softball teams in the city leagues. This year, they are joined on the athletic field by the United Automobile Workers team.*

WAR RELIC—*Included in the latest collection of old automobiles and other vehicles to be purchased by Henry Ford is an auto used by Crown Prince Wilhelm of Germany on the Western Front during the world war. Thirty flat cars carried the entire collection to Dearborn from San Jose, Cal., where it was bought from the late T. C. Wohlbruck.*

THEY MUST BE GOOD—*Not only is the British air line which bought five American airplanes pleased with them, and says so in its advertising, but local reports indicate that there has been an increase in air traffic since the new ships were put into service. Safety and comfort features are stressed by the air line operators.*

RADIO—*At least one hitch-hiker is reported to have turned down a ride in a car without a radio. Sooner or later somebody will inquire about the beds in a trailer.*

CHICKENS—*No longer must a New York State motorist report an accident to a chicken under amendments to the traffic law just approved. Cars striking horses, dogs or several varieties of animals classed as cattle must be halted and reports made.*

All Show Space Drawn

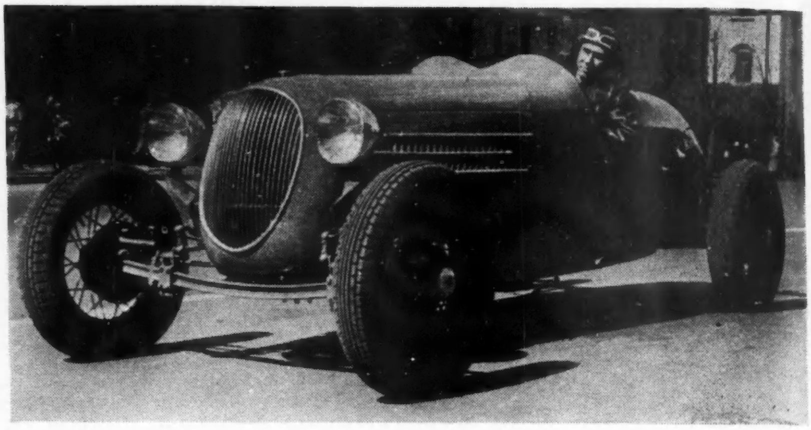
Applications for exhibition space at the National Automobile Show exceeded the amount available by several thousand square feet, and all available space was allotted to 22 makes of passenger cars and 7 makes of commercial vehicles at the show drawings in Detroit June 3. Space for the accessory, shop equipment and touring trailer sections will be allotted at a special drawing to be held later this month.

Passenger car makes assigned space are: Auburn, Buick, Cadillac, Chevrolet, Chrysler, Cord, DeSoto, Dodge, Graham, Hudson, Hupmobile, LaSalle, Lafayette, Nash, Oldsmobile, Packard, Pierce-Arrow, Plymouth, Pontiac, Studebaker, Terraplane, and Willys. Commercial vehicles assigned space are: Chevrolet, Dodge, Plymouth, Pontiac, Reo, Terraplane and Willys.

Dividends Declared

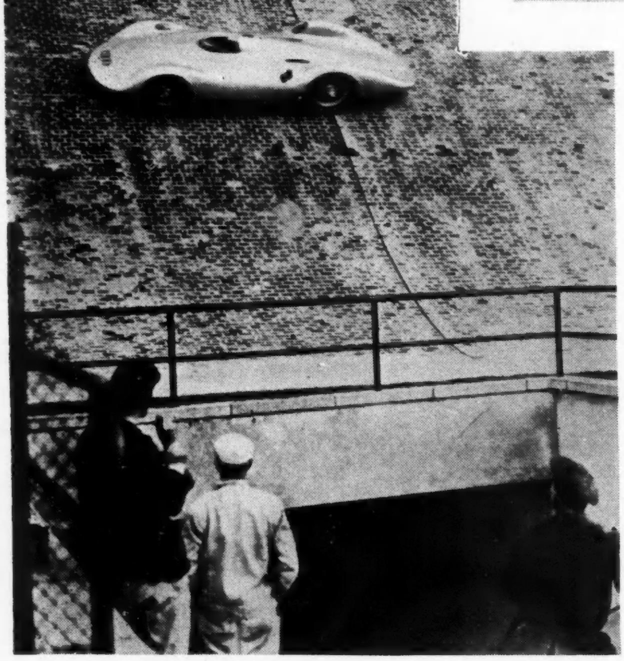
		Record	Payable
Autocar	q 75¢ prf.	June 19	July 1
Bohn Aluminum & Brass	75¢	June 15	July 1
Budd Wheel	q $1.75 1st prf.	June 16	June 30
Budd Wheel	ext. $1.75 1st prf.	June 16	June 30
Budd Wheel	20¢ com.	June 16	June 30
City Auto Stamping	q 15¢	June 15	July 1
Columbus Auto Parts	acc. $1 prf.	May 14	May 21
Comm. Inv. Tr.	q $1 com.	June 5	July 1
Comm. Inv. Tr.	q $1.06¼ prf.	June 5	July 1
Covered Wagon	init. q 37½¢ "A"	May 26	June 15
Diamond T	q 25¢	June 15	July 1
Electric-Auto Lite	80¢ (incr.)	June 17	Ju'y 1
Elect. St. Batt.	q. 50¢ com.	June 9	June 30
Elect. St. Batt.	q 50¢ prf.	June 9	June 30
Fruehauf Trailer	init. 25¢	June 20	July 1
Hercules Motor	q 25¢	June 15	June 30
Houdaille-Hershey	q 62½¢ "A"	June 19	July 1
Houdaille-Hershey	37½¢ "B"	June 19	July 1
Int. Harv.	q 62½¢ com.	June 15	July 15
King-Seeley	q 27½¢ cvpr.	——	July 1
King-Seeley	40¢ com.	June 5	June 15
Motor Products	$1	June 19	June 30
National Battery	q 55¢ prf.	June 14	June 30
Peninsular Metal Pdts.	30¢	May 28	June 12
Perfect Circle	q 50¢	June 18	July 1
Perfect Circle	ext. 50¢	June 18	July 1
Raybestos-Manhattan	q 37½¢	May 28	June 15
Rolls Royce, Ltd. (Amer. ord. Cts.)	final 54.4¢	April 16	June 5
Waukesha Motor	q 25¢	June 15	July 1

Racing Interest Grows Abroad; New Cars Tried



Sovfoto

SOVIET, too, is building racing cars and will hold several cross-country races this summer to arouse interest in automobiling. This is one of five cars built for the contests. It is powered with a G.A.Z. engine and is said to have a top speed of 130 kilometers an hour. It was assembled in the laboratory of the Central Automobile Club in Moscow.



Acme

GERMAN version of a modern racing car making a fast tune-up lap at the Avus Track in preparation for the forthcoming international races there. The driver is Rosemeyer of the Auto-Union team. The car is much more streamlined than most of those on the world's fast tracks.

Alcohol Blends Gaining

Backers Say 250 Service Stations Selling Them

About 250 service stations in Kansas, Missouri, Nebraska, Iowa, North and South Dakota and Minnesota are marketing motor fuel blends of alcohol and gasoline, it was stated by Dr. Leo M. Christensen of the Farm Chemurgic Council, who read a paper on the subject at the third Dearborn Conference of the council recently. Dr. Christensen said he expected the number of outlets to increase to 1000 within two or three months.

The blended fuel is made from gasoline and a fluid called "Agrol" which contains 78 per cent of ethyl alcohol, 6 per cent of other ingredients derived from farm products and 16 per cent of materials produced from coal. The present formula for Agrol contains but 0.8 per cent gasoline by volume. From the manufacturing plant at Atchison, Kan., it is carried to the refinery or bulk blending station where the blending takes place. The present plant is rated at 10,000 gal. of anhydrous ethyl alcohol in 24 hours.

The present cost of Agrol fluid is based on corn at 60 cents a bushel and the resulting alcohol costs 23.72 cents a gallon.

Not all gasolines respond satisfactorily to the addition of alcohol, said Dr. Christensen. The producers of the Agrol therefore require samples of the gasolines proposed for use and test them. In general, he said, gasolines with 63 to 65 octane anti-knock ratings are used.

Three grades of blended gasoline are marketed today—Agrol 5, 10, and 15. Agrol 5 contains from 5 to 7½ per cent of Agrol fluid by volume and is said to have an anti-knock value equal to that of the best grades of regular gasolines. Agrol 10 containing from 7½ to 12½ per cent Agrol fluid is suitable for the highest compression engines. Agrol 15 containing from 12½ to 17½ per cent Agrol fluid is said to exceed the quality of the best aviation gasolines. It is said that interest is gradually shifting to the use of Agrol 10 for most heavy-duty automotive uses.

So far as cost is concerned, Agrol 5 is being sold at the price of "regular" gasolines, while Agrol 10 and 15 command a premium of 1 to 2 cents per gallon.

W. W. Buffum of the Chemical Foundation, Inc., New York, and Dr. Harry Miller of the Chemical Foundation of Kanasa Company, Atchison, Kan., read papers on the practical and economic aspects of using alcohol-gasoline blends.

New Record Set at Indianapolis

Shaw Wins by 2.16 Sec. With 113.580 m.p.h. Average; Finishes on One Quart of Oil; Hepburn Nearly Catches Him

Record speed and the closest finish in the history of the event marked the 25th Indianapolis 500-mile race on Memorial Day. Wilbur Shaw of Indianapolis, driving a Shaw-Gilmore Special without relief, won with an average speed of 113.580 m.p.h. Second by 2.16 seconds was Ralph Hepburn of Los Angeles, driving a Hamilton Harris Special. He stopped for gasoline at the 183rd lap, after having had a relief driver during the race when he was temporarily overcome by the heat, and was able to come close to overtaking Shaw near the finish.

The story behind the close finish was the loss of oil by Shaw. When the AAA drained the crankcase after the race, the official observers found only one quart left. As Shaw went into the 190th lap, his oil pressure gage showed a reading of zero on the straightaways. On the turns it showed only a few points as centrifugal force threw the small remaining quantity of oil into the engine. The car could have been driven faster, but Shaw held the speed down for fear of burning up his engine. Had the race gone a few laps further, he would have had to withdraw.

	Driver and City	Car	Aver. in m.p.h.
1.	Wilbur Shaw, Indianapolis	Shaw-Gilmore Special	113.580
2.	Ralph Hepburn, Los Angeles	Hamilton Harris Special	113.565
3.	Ted Horn, Los Angeles	Miller-Hartz Special	112.079
4.	Louis Meyer, Huntington Park, Calif	Boyle Valve Special	110.730
5.	Cliff Bergere, Hollywood, Calif	Midwest, Red Lion Special	108.935
6.	Bill Cummings, Indianapolis	Boyle Valve Special	107.123
7.	Billy Devore, Kansas City	Miller Special	106.995
8.	Tony Gulotta, Kansas City	Burd Piston Ring Special	105.015
9.	George Connor, San Bernardino, Calif	Marks-Miller Special	103.830
10.	Louis Tomel, Portland, Ore	Sobonite Plastic Special	101.825

Of great interest in the pacing of Shaw's car was the pit work done by Leon Duray whose car dropped out early in the race. He took over the handling of Shaw's pit and with his vast experience in racing was able to calculate how long it would take Hepburn to catch Shaw at the speed Hepburn was traveling. With the use of blackboard signals, he permitted Shaw to hold his speed down to about 110 m.p.h. for the last ten laps, which was absolutely essential if Shaw's car was not to burn up.

Much of the credit for Shaw's victory can be placed in the scientific streamlining of his car. Shaw is reported unofficially to have averaged about 12 miles to the gallon of gasoline, an unusually good figure at the high speed for the 500 miles.

The superiority of both Shaw's and Hepburn's driving also had a great deal to do with the infrequency of their pit stops. Other drivers, with perhaps equally good cars mechanically, were tearing their tires to ribbons by the way they hit the turns. Neither Shaw nor Hepburn cut down speed much on the turns, but by deft handling kept the cars from skidding and wearing out the tires. A total of 70 tire changes were made by all cars.

It was the consensus of opinion that all the accidents in race and trials were caused by the same thing—failure of crankshafts. So far as anyone knows, drivers are powerless to prevent trouble in such cases because rear wheels lock and throw the cars into lurching spins, usually to the left. In each instance this year, the crankshafts had seen a great deal of service before the trials that preceded the race, and it may be that designers have overcome the weaknesses.

The mystery of the race was the direct tramp which appeared in Shaw's car at low speeds, particularly on the turns. It disappeared at high speeds.

Above are the first ten cars to finish the race.

Fisher Body Expands

Adds Flint Press, Die Shop To Supply Branches

Award of contracts for the construction of a new press room and dies shop at the Flint Unit No. 1 of the Fisher Body division of General Motors Corp. was announced by E. F. Fisher, general manager.

The new structure will add approximately 170,000 sq. ft. of working floor space to the Flint plant, bringing the total area of this operation up to 2,350,000 sq. ft. and making it one of the largest single units devoted to body building in this industry.

This unit produces a line of complete bodies for all models of Buick cars together with convertible coupes and sedans for practically the entire General Motors line. In addition to this, it produces knocked-down parts shipped in large quantities to the new Linden division, Linden, N. J. and to the Southern California division at Los Angeles.

The new addition will provide this unit with complete press shop equipment, sufficient to supply all stampings for its production. Heretofore a large percentage of these stampings have been produced in other plants. The new addition will make it possible to produce all required body parts in the No. 1 unit, thus eliminating its dependence on other operations.

It is calculated that these additional facilities will provide employment for 500 to 1000 men in addition to those new engaged in the plant.

Construction will begin immediately and it is anticipated that it will be completed early in October.

Publications Available

The **"Welding of Stainless Steel"** is the title of a booklet just published by the Republic Steel Corp.*

A new booklet, "A Guide for Sheet Metal Workers," has just been published by United States Steel Corp. Subsidiaries. It includes **fabricating hints** and various other data.

Precision methods used in the manufacture of International Harvester's products are described in an illustrated booklet published by the company. "Precision Manufacture" is the title.*

The Spring, 1937, issue of "Filmo Topics," published by the Bell & Howell Co., contains an article describing the uses of **industrial motion pictures.** The company also offers a brochure on the subject.*

A new slide rule indicator for use in **selecting electrical instruments** has been published by the Westinghouse Electric and Manufacturing Co.*

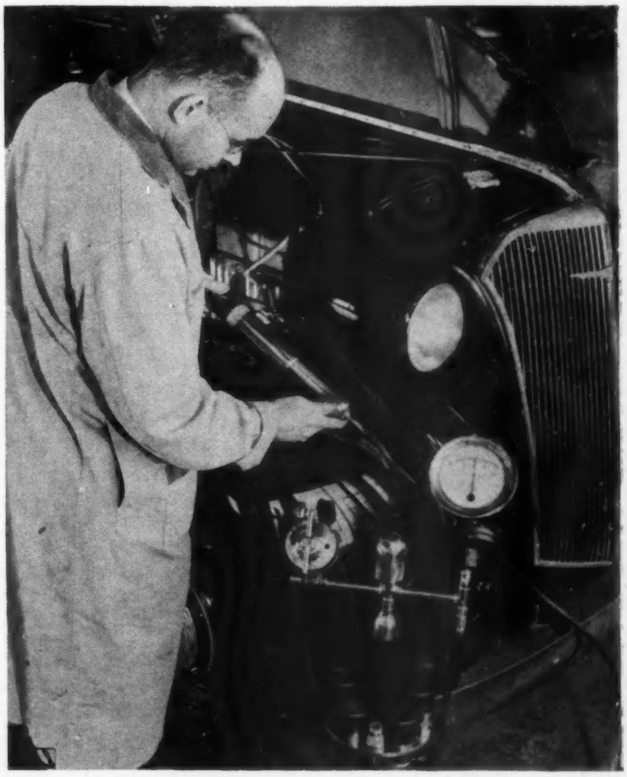
Tables for converting temperatures from centigrade to fahrenheit scale, together with the melting points of known chemical elements, atomic numbers, symbols and atomic weights has been published by the Government Printing Office. The publication is M 126.

Chicago Metal Hose Corp. has published a new **catalog** of its products including technical data for their use.*

Two publications by the Chamber of Commerce of the United States, the **Development of Trade Associations,** and the **Use of Trade Association Statistics in Manufacturing,** have been issued.*

Wilmington Fibre Specialty Co. has issued a technical catalog, listing its products, and their uses and methods of application. The concern makes a **laminated phenolic insulation.***

* Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.



VOLUME of the combustion chamber of a new Chevrolet is being measured by the use of sound waves. Compressed air is applied to a whistle screwed into the engine in place of a spark plug and air at the same pressure is applied to another whistle attached to the end of a variable - volume chamber held by the engineer. When the pitch of the two whistles is identical, the reading of the calibrated chamber gives the volume of the combustion chamber.

AMA Elects at Meeting

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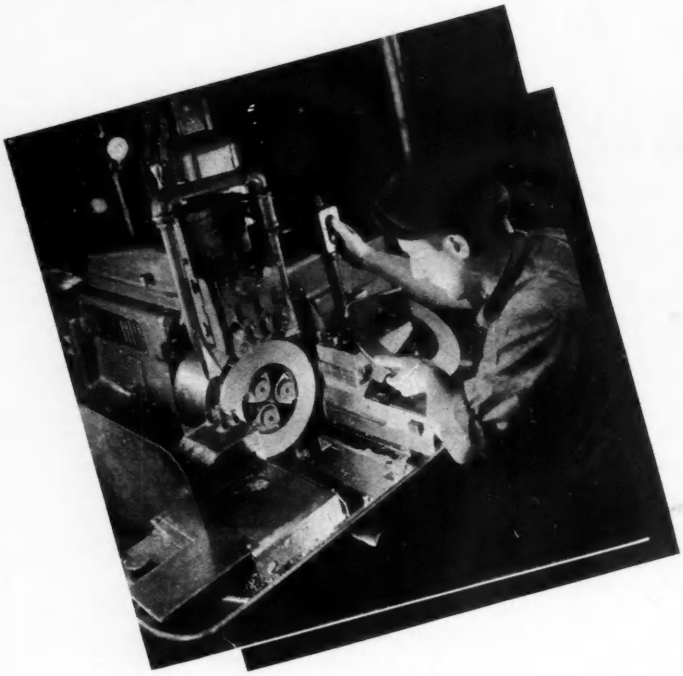
Fig. 1

12 in. Sundstrand Stub lathe for rough- and finish-turn O.D. and face clutch pressure plate



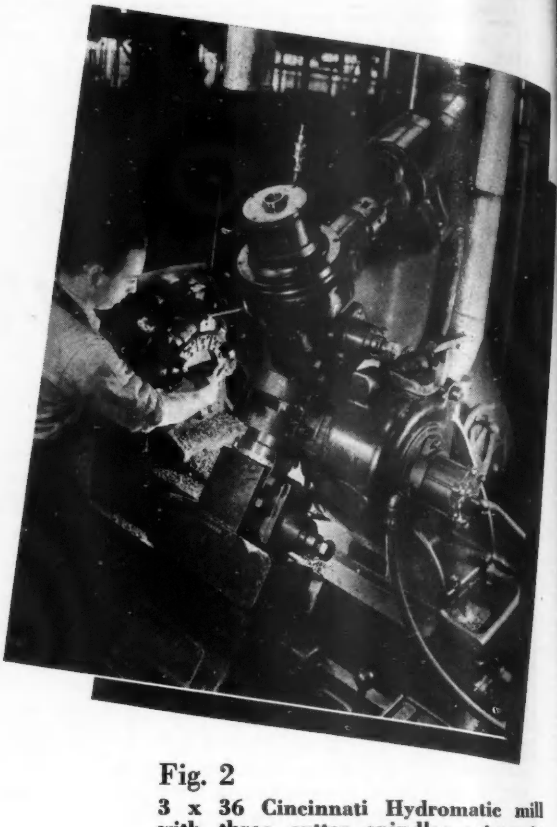


Fig. 2

3 x 36 Cincinnati Hydromatic mill with three cutter spindles set-up to straddle-mill sides of three lugs on pressure plate

Big Production from Compact

Standardization of details and equipment enabled Borg & Beck to produce 1,500,000 clutches in 1936 with a wide variation in specifications and models

By Joseph Geschelin

BORG & BECK, Division of Borg-Warner Corp., Chicago, Ill., one of the largest producers of automotive clutches, boasts a manufacturing operation of more than usual attractiveness due to the nature of the specialty as well as the simplicity and compactness of process.

Although the entire manufacturing facilities in Chicago are housed within a floor space of only 169,250 sq. ft., they produced in 1936 over one and a half million clutches. The compactness of the layout has been developed over a period of years by a process of standardization of details and equipment but the implications of even these factors can be appreciated only when one considers that Borg & Beck makes four basic types of passenger car clutches as well as four basic types of heavy-duty clutches; also the fact that the eight basic models include 47 different specification variations which must be handled over the same machines and assembly lines.

During the past few months the company made some important additions and changes in the plant facilities, the most interesting of these being a new production line for the 9 and 10 in. clutches. They now operate three production lines—one each for the 9 and 10 in. clutches; and one new line for both 9 and 10 in. It is a characteristic of these lines that they combine complete machining of the pressure plate, as well as balancing and assembly. The details of the new line are given elsewhere in tabular form.

An outstanding feature of the new line is the fact that it has been equipped with special production machines of the latest type, a few of the most unusual items being illustrated in the pictorial section.

To assure worker-comfort on the main lines as well as in other parts

THIS IS THE FOURTEENTH IN THE SERIES OF MONTHLY PRODUCTION FEATURES

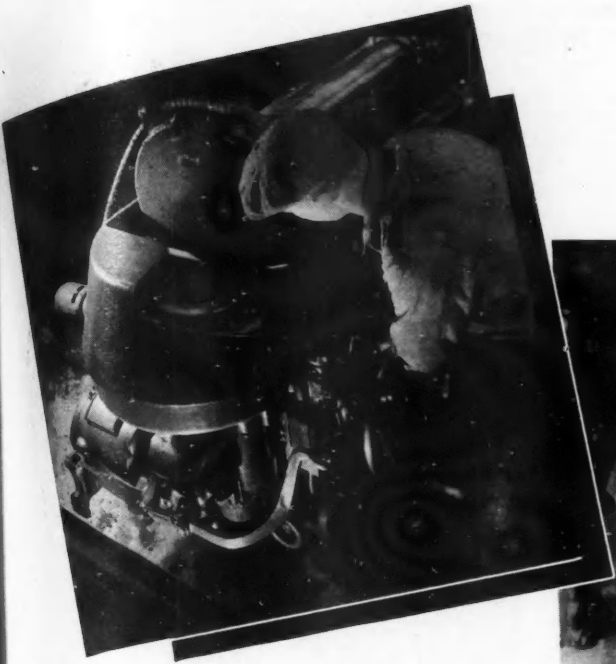


Fig. 3

Pressure plate friction face is ground flat and within 0.002 in. parallelism on No. 25A Heald rotary surface grinder

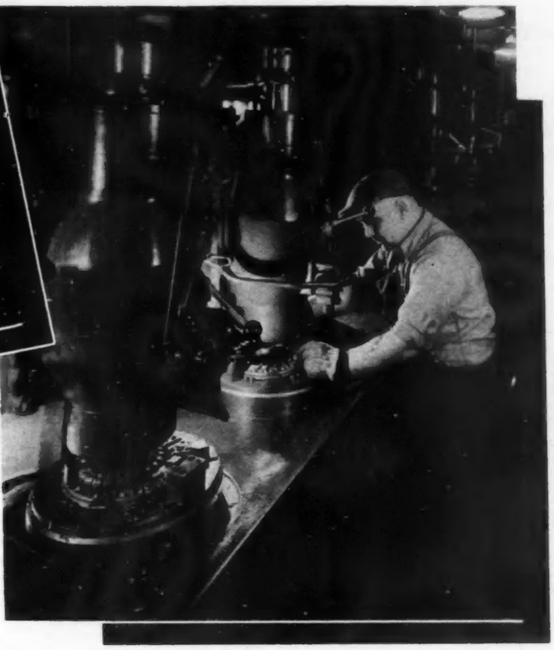


Fig. 4

Pressure plate lugs are undercut on this special double-spindle DeVlieg mill with automatic chucking fixtures

Shop Layout

of the plant, they have installed suction exhaust ducts on all machines handling dry machining of metal or fabric elements.

A rather neat problem is presented in the drilling and countersinking of clutch facing discs. This is an unusually abrasive material and one which does not tolerate the conventional cutting tool materials. High-speed steel combination tools were used at one time but had to be abandoned due to the need for frequent replacement. Since then they have adopted a combination drilling and countersinking tool, in which the countersinking section is tipped with Carboloy.

Rather remarkable performance has been achieved by using a special cemented tungsten carbide tooling in turning steel forgings. The part is a driven plate hub made from an SAE 1035 steel forging and turned, two at a time, on an 8 in. Fay automatic. Turning tools are tipped with Vascoloy-Ramet, Grade E. Turning is done at the rate of 500 f.p.m. with 0.011 in. feed. Over a long period of time, these tools have averaged a life of 450 pieces per grind.

Quality control is a basic requirement in this plant since the clutches have certain unique engineering principles which depend upon precise manufacturing tolerances and exact balance. Consequently, we find that inspection operations form an integral part of the work along the production

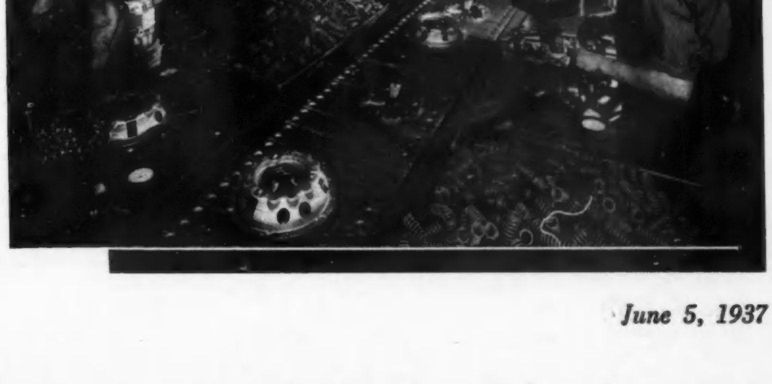


Fig. 5

Further down the new clutch line is the clutch cover assembly station served by the overhead feeder conveyor

line. Photographs of some of the special inspection devices, as well as of one of the new GMR balancing machines will be found in the pictorial section.

As mentioned earlier, the new pressure plate line has many things about it that are of interest to production men. The complete activity on the machining end of the line comprises six steps which are given below.

Clutch Pressure Plate

1st Operation.

Rough and finish turn outside diameter and face (Fig. 1).
12 in. Sundstrand Transverse Feed Stub Lathe. One operator running two machines using Vascoloy-Ramet tools. Three-jaw, air-operated equalizing chuck. These machines require 10 hp. motors, equipped with push button station starters. Cutting compound is required for this operation, to keep pressure plate cool, as well as to increase the tool life. Spindle speed approximately 75 r.p.m.; feed on slides 0.070 in.

2nd Operation.

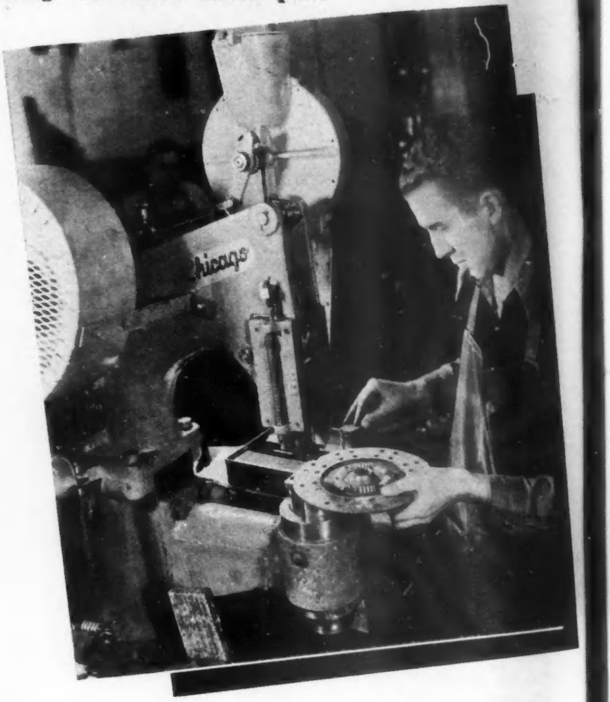
Straddle Mill Sides of three lugs. (Fig. 2). 3 x 36 in. Cincinnati Hydromatic Mill with three especially arranged cutter spindles with 7½ in. Dia. H.S. Half Side Mills. Reciprocating table with two six-jaw air-operated clamping fixture, hydraulic approach, feed and return.

3rd Operation.

Grind flat friction face within 0.002 parallelism (Fig. 3). This operation is performed on a No. 25A Heald Grinder, using a 16 in. x 2 in. x 8 in. hole—46M Norton wheel, counterbored on both sides. The wheel spindle is driven by a 20 hp. motor while the table or chuck spindle is driven by a 5 hp. motor. The pressure plate is held in a three-jaw hand-operated chuck. Grinding compound is used. Inspection after this operation is mainly for quality of finish.

Fig. 6

This No. 92 Chicago riveter is a new machine with double rivet race ways for automatic riveting of facings on clutch driven plate



4th Operation.

Hook mill three lugs (Fig. 4). Special double vertical spindle DeVlieg mill with two automatic chucking fixtures mounted on rotary tables.

5th Operation.

Drill three eyebolt holes. No. 217 Baker drill equipped with multiple spindle head, vertical adjustment to each spindle.

6th Operation.

Mill slots in sides of each of 3 lugs. No. 217 Baker drill equipped with special six-spindle milling head having endwise and sidewise adjustment. Air-operated holding fixture.

Process Highly Specialized

Most of the process in this plant is so specialized that we have decided to vary our usual method of presentation by giving below complete details of a selected group of operations. In the majority of cases, the description is supplemented by a suitable illustration in the pictorial section.

Hook-Milling Clutch Pressure Plate Lugs (Fig. 4)

An operation on the new line using a special double vertical spindle DeVlieg milling machine, with two separate rotary tables, with fixtures mounted on bed of machine. A 6½ in. diameter form-relieved high speed milling cutter is used. The spindles are individually driven by a 7½ hp. motor through a chain drive. Spindles have a vertical motion for positioning into and away from cutting position, operated hydraulically by a lever-operated hydraulic valve. The rotary table and spindle are concentric with each other when in the idle position. When hydraulic valve is engaged to plunge cutter spindle downward into cutting position, an electric limit switch is tripped, starting the rotary table feed motor. The fixtures mounted on rotary tables are positioned into an eccentric path with cutters, by means of a large circular cam on under side of fixture. When one complete revolution of fixture is made, and all three lugs have been hook-milled, the circular cam positions fixture again concentric with cutter spindle, thus allowing the cutter to be raised away from work. On the upward stroke of the spindle, the limit switch is again tripped, stopping the rotary table feed motor. The pressure plate is located in fixture by registering on the finished turned outside diameter and held by three equally spaced spring-operated clamping jaws.

Clutch Cover Assembly (Fig. 5)

This operation on the new line is performed on a specially designed air-operated fixture, suitably equipped with locating pins and blocks, to insure proper alignment of component parts before air clamping pressure is applied. The lock nuts are threaded on

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D. E. Gamble	**Vice President and General Manager**
T. L. Knecht	**Factory Manager**
Harold Nutt	**Director of Engineering**
J. T. Branit	**Master Mechanic**
E. H. Lipke	**Chief Inspector**
H. V. Reed	**Chief Engineer**

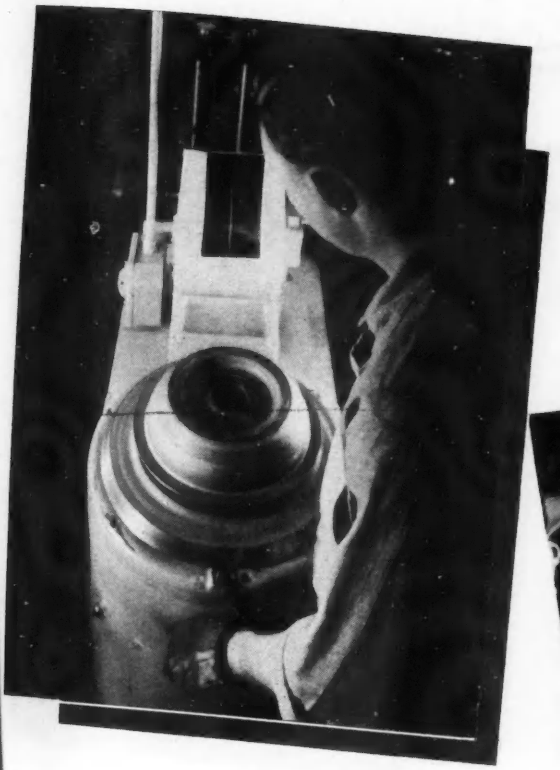


Fig. 7

Clutch cover assemblies are dynamically balanced on this GMR balancing machine running at 600 r.p.m.

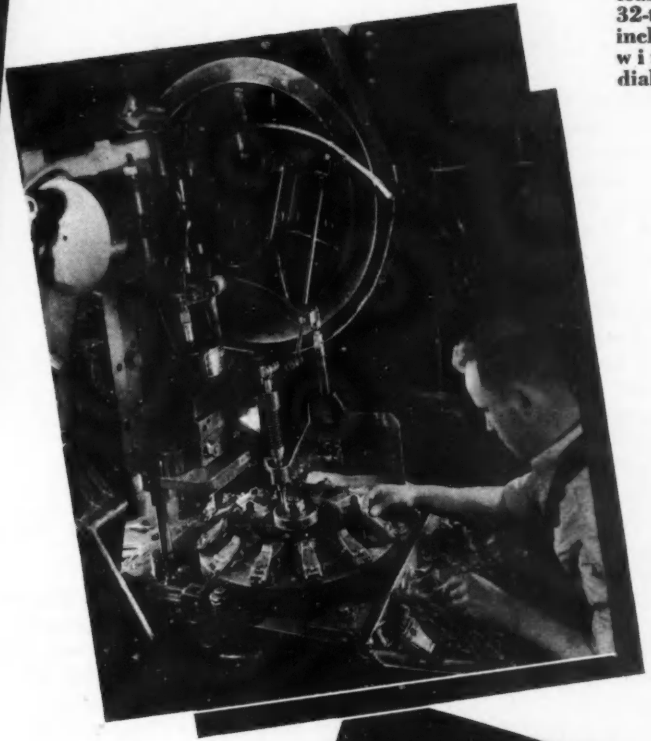


Fig. 8

Staking clutch release levers on a 32-ton open back inclinable press with 12-station dial feed fixture

the three equally-spaced eyebolts, extending through top surface of cover by use of small electric wrenches. Be fore lock nuts are staked or locked for setting, a dial indicator reading is taken of parallel setting of throwout end of the three release levers; also a similar reading of the pressure plate ground friction face in relation to the six embossed bolting pads on flange of clutch covers.

The overhead conveyor is used for carrying covers to assemblers from a distance of approximately 60 ft., where the covers are reamed, washed and stamped for proper identification.

Riveting Facings on Clutch Driven Plate (Fig. 6)

The equipment is a No. 92 Chicago double spindle riveter, with double rivet race-ways, double drivers and double anvil arrangement for inserting into and setting two brass tubular rivets at one stroke of the machine. First, the formed cushion spring shown in operator's right hand is placed on fixture over two disappearing spring loaded pins; the driven plate subassembly is placed on same two pins and finally the facing, thus aligning the three component parts with the rivet setting drivers. The assembly is then indexed until sufficient rivets are assembled in one side of plate. In the following operation the plate is turned over and a facing only riveted to opposite side in the same manner.

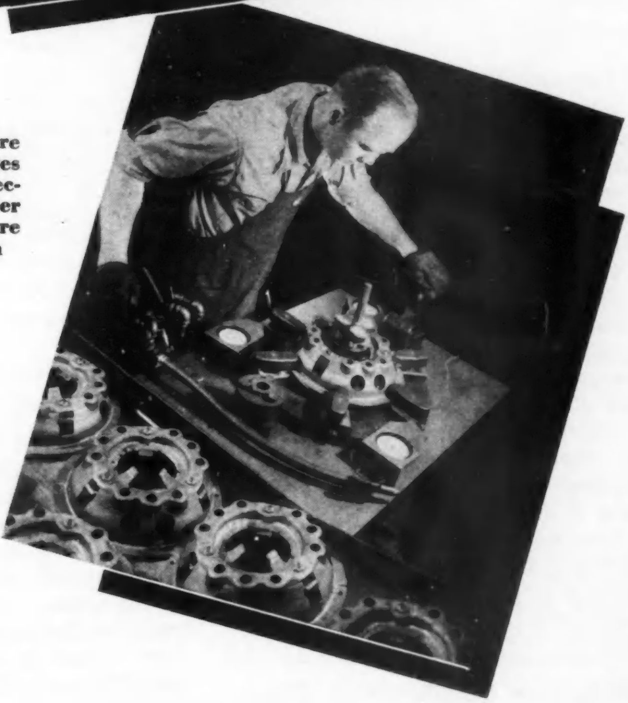


Fig. 9

Air-operated fixture fitted with dial gages is used for inspection of release lever setting and pressure plate parallelism

Operations illustrated in Figs. 7, 8 and 9 are described on the next page

Balancing Clutch Cover Assemblies (Fig. 7)

Clutch cover assemblies are statically balanced within very accurate tolerances, readings being taken when cover assembly is revolving at 600 r.p.m. The adapter mounted on main spindle of machine is equipped with six hardened and ground locating pins, which register in six reamed bolt holes in flange of cover. The concentricity of the spindle, adapter and locating pins is very accurately held, which is also true of the clutch assembly.

The chart shown on upper part of machine is graduated with vertical lines, representing ounce-inches, or parts thereof, and also horizontal lines, representing degrees, thus indicating the diametrical location of unbalance. The highest point of waver or curve in the light line is read on the chart in the same manner as a graph chart, thus locating position of unbalance, also the amount. The adapter is then stopped. The lower beveled edge of adapter is also graduated in degrees—corresponding to reading taken on chart for location of unbalance. This enables the operator to locate immediately the heavy side of the clutch assembly. Correction is made by drilling metal from the pressure plate, it being necessary to take assembly off of adapter for drilling. There are clearance holes on the top side of the cover to allow the drill to reach down through the assembly to drill into pressure plate. After drilling, the assembly is again put on the adapter for a check reading.

Balancing Driven Plate Assembly

All driven plate assemblies are statically balanced within very accurate limits, running at a speed of 1200 r.p.m. Reading for amount and location of unbalance is identical to that described for clutch cover assemblies.

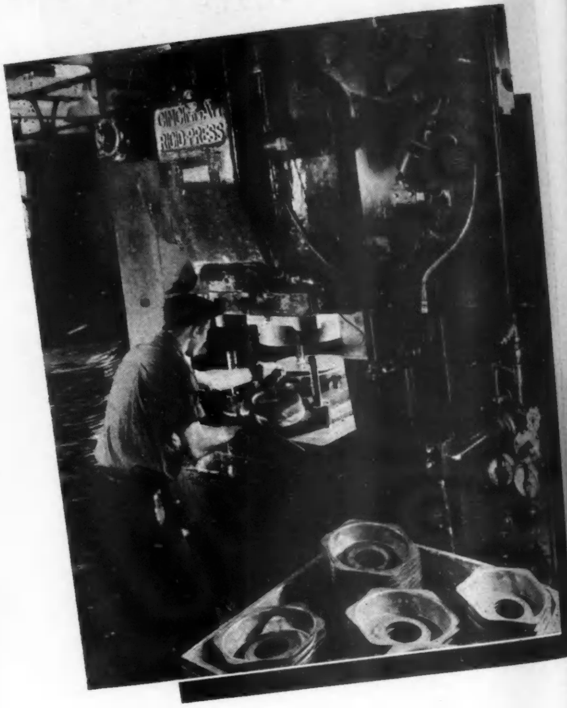
Correction for unbalance is made by addition of weight opposite the indicated heavy side of assembly. The weights consist of three different thicknesses of metal—0.035 in., 0.047 in., and 0.062 in.—in pan anchored to front face of machine. The weights are inserted in holes provided directly adjacent to the inner diameter of facings. When proper thickness of weights is inserted to bring the assembly within required balance tolerance, these weights are clinched over on a specially built air-operated clinching fixture.

Broaching Clutch Driven Plate Hubs

This operation is performed on a No. 3 Oilgear hydraulic single spindle horizontal broaching machine, one operator running two machines. High speed steel broaches are used at the cutting rate of 18 ft. per min. Sulphur base cutting oil is used as a lubricant which aids tool life materially. The work is an SAE steel forging. Broaches are approximately 40 in. in length, with bore scraping teeth at the front end to first size the bore on root diameter of hub before spline cutting is started.

Fig. 10

600-ton Cincinnati Rigidpress is used for first forming operation on clutch cover



Staking Clutch Release Levers (Fig. 8)

Operation is handled on a 32-ton open back inclinable press, equipped with a 12-station dial feed. There are 12 locating nests on top of the dial, each holding one lever at a 50-degree angle to the horizontal. The lever is located on the nest by a pilot block, registering in the rectangular opening and the slot at the wide end of the lever. This method affords location in both directions. The lever being held at a 50-degree angle is lined up properly with staking punches mounted in punch holder. In this operation the metal is extruded at two points, equally distanced from rectangular opening, into the fulcrum pin seat on the inside.

Inspection Release Lever Setting and Pressure Plate Parallelism (Fig. 9)

A specially designed air-operated fixture is used for this purpose, equipped with dial indicators, the center cluster of three being used to check setting of the contact end of lever within a parallel plane of given tolerance. The three equally spaced larger dial indicators, shown at outer edges of base plate of fixture, indicate the parallelism of the friction face of pressure plate. The stem of indicators is operated by a lever on undersize of fixture, actuated by a vertical pin, the upper end of which contacts the ground or friction surface of pressure plate. This check is made on 100 per cent of clutch production.

First Forming Operation on Clutch Cover (Fig. 10)

Here is a heavy-duty operation on a 600-ton Cincinnati Rigid press equipped with a double 24 in. dia. x 4 in. stroke air cushion, mounted under bed. The conventional type of die construction is used with the hardened and ground draw ring mounted in hardened pins, which extend through the bed of the press to the pressure pad of air cushion.

The cover is made from 0.109 in. thick SAE 1010 deep-drawing hot-rolled stock. The blank before drawing is hexagon shaped, with corners rounded, and the center hole of blank is of a developed diameter to allow sufficient metal to be drawn from hole, as well as outside periphery, so as not to stretch or over tax metal at any point. Drawing compound is used.

Cushion Parallel Checking Machine for Clutch Driven Plate (Fig. 11)

A Pittsburgh power-driven style A Brinell machine is used for this purpose. The operation of the checking cushion and parallelism is as follows: The driven plate assembly is placed on the bottom plate in a centralized position and the air pressure applied,

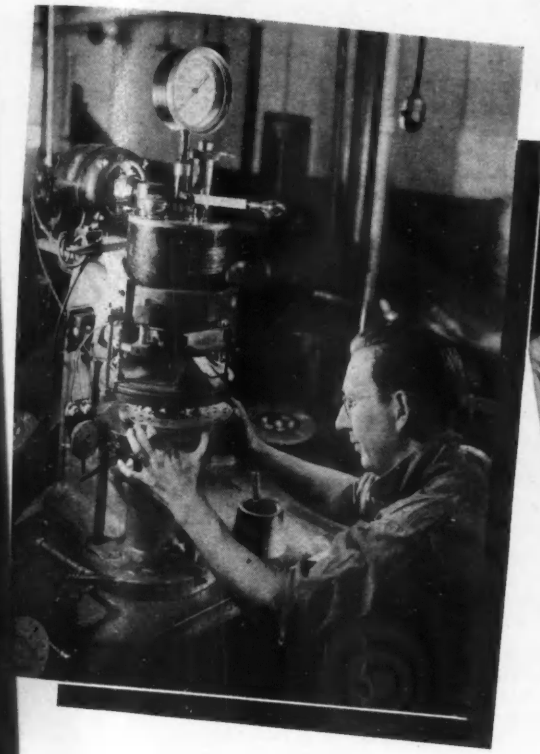


Fig. 11

Pittsburgh power-driven Brinell machine has been transformed to serve as inspection device for clutch driven plate

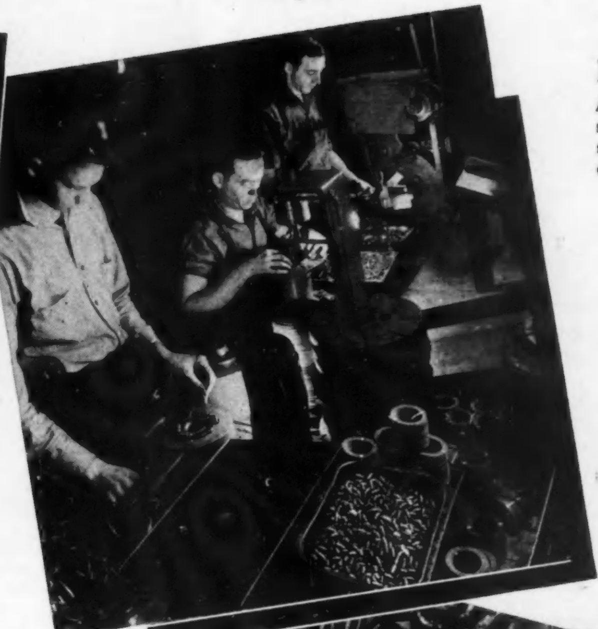


Fig. 12

Another assembly station showing set-up for clutch driven plate assembly

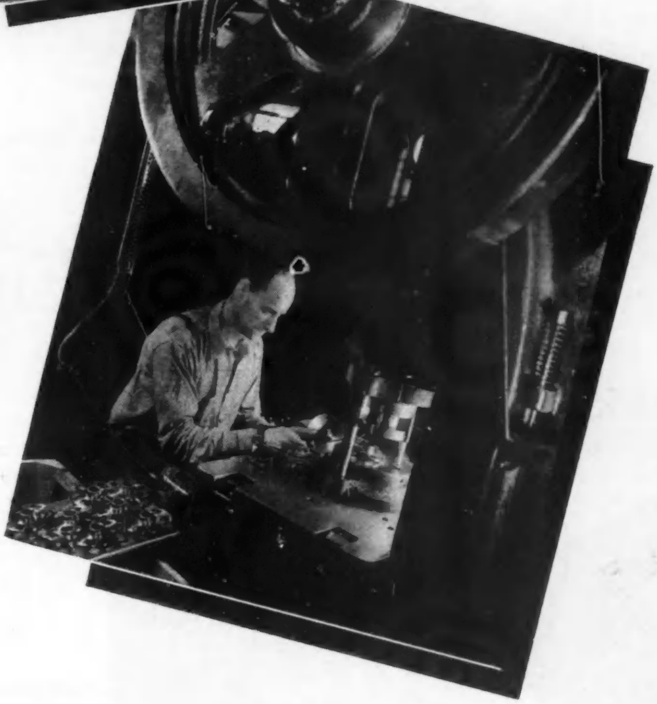


Fig. 13

56-ton open back inclinable press is used for piercing stop pin notches and six spring windows in clutch driven plate hub

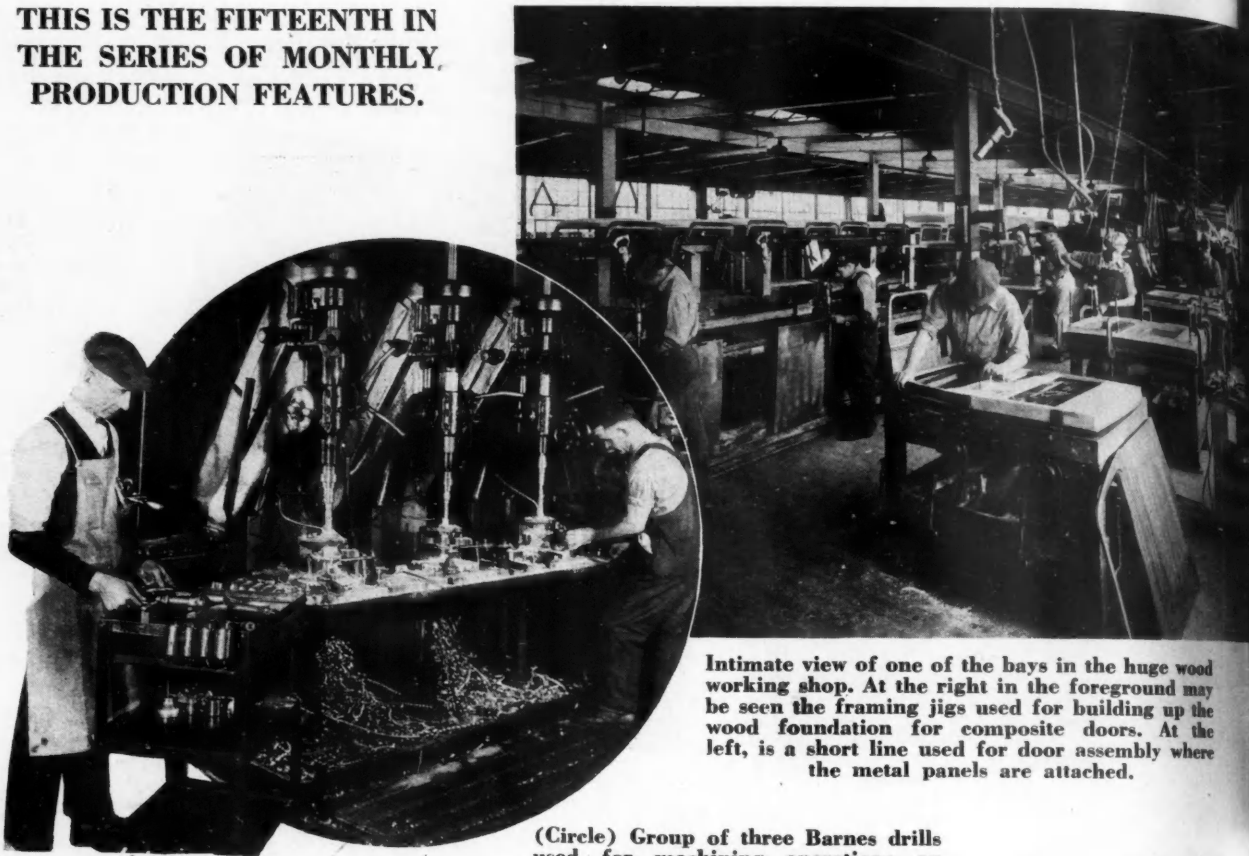
which brings the assembly up into position for application of the Brinell load. As the assembly goes into its raised position, it picks up the minor or dead load plate, which is hung through the bolts from the side of the frame around the cylinder. The Brinell load is then applied. (The release valve should be set so that a maximum pressure of 1300 lb. is applied.) The machine will hold this load until the pressure is released. The indicator for the checking cushion is next read and the Brinell pressure released. The pressure plate recedes, leaving the minor or dead load still applied. The reading is then taken in this position and the inclusive reading between the major load of 1300 lb. and the minor load of 12 lb., after the pressure has been applied, is the cushion reading.

Parallel thickness is checked automatically by the light beam which goes through the plugs contacting when the parallelism exceeds the distance of separation between them. When setting the plugs to the 0.005 in. separation, a master plate, absolutely parallel to the approximate thickness of the driven plate assembly, must be used to insure a satisfactory check.

Clutch Driven Plate Assembly (Fig. 12)

The illustration shows the front end of the driven plate assembly line, with all components used, with the exception of clutch facings. In the first fixture, damper springs are inserted into pockets and three lock wires for one side of plate are strung through six springs. The springs are then compressed by means of a foot-operated arm, attached to center floating plate of fixture. After compressing strings, the driven plate large member is placed over springs and friction washers, stop pins, hub and top plate assembled as one unit. This sub-assembly then is passed on to next operator, who inserts three more lock wires through springs on opposite side of assembly. In doing this it is necessary to compress the inner part of assembly, to allow sufficient space on inside of springs for lock wires to enter. From this point the sub-assembly is passed along to a third operator to have the small lock plates placed over the ends of stop pins on each side and then spin heads on stop pins, holding the complete damper assembly intact. From this point the assembly is read for the riveting-on of clutch facings.

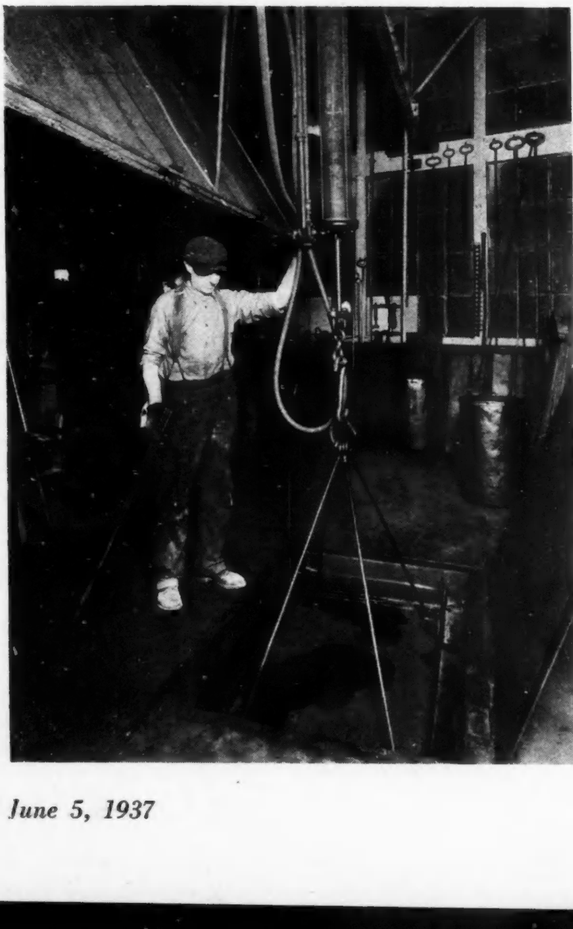
THIS IS THE FIFTEENTH IN THE SERIES OF MONTHLY PRODUCTION FEATURES.



Intimate view of one of the bays in the huge wood working shop. At the right in the foreground may be seen the framing jigs used for building up the wood foundation for composite doors. At the left, is a short line used for door assembly where the metal panels are attached.

(Circle) Group of three Barnes drills used for machining operations on spring shackles. The inspector at this station may be seen at the left.

Many Models Emerge From Federal



Quenching is an important process in Federal's heat treating department. Note the Curtis air-hoist which facilitates handling of the heavy loads.

JUST two years ago, the Federal Motor Truck Co., celebrated its quarter century of service in the truck field, harking back to the establishment of its first small factory in Detroit in 1910.

Today, the Federal factory boasts a floor space of almost 500,000 sq. ft., with plant buildings located on a property covering more than 8½ acres. The company builds a complete range of motor trucks of every wanted type, including the popular cab-over-engine job. Standard and custom built cars and bodies are also produced.

A fast-growing newcomer in the Federal family is the camp trailer which is made in two types—standard and deluxe. The same unit with special interior treatment is built for commercial display purposes. It is made of composite construction with a sturdy wood framing built in Federal's big woodworking shop.

A visit to the plant will show convincingly that they have complete facil-

(Circle) 1937 Federal trucks moving toward the end of the chassis assembly line. This plant boasts an assembly line conveyor extending some 600 ft. of straight length.

(Below) General view in spacious machine shop in the Federal truck plant

Looking down one of the bays in Federal's press shop. This department produces the sheet metal parts used in the 1937 line.

Production Line

Camp trailers, a newcomer to the Federal line finds complete facilities for economical production

ities for this type of operation. Here will be found a machine shop of moderate size equipped with the familiar types of universal production machinery suitable for the machining of a variety of brackets, pedals, and other attachment parts. This is supplemented by a heat-treating department to take care of the parts made in the plant.

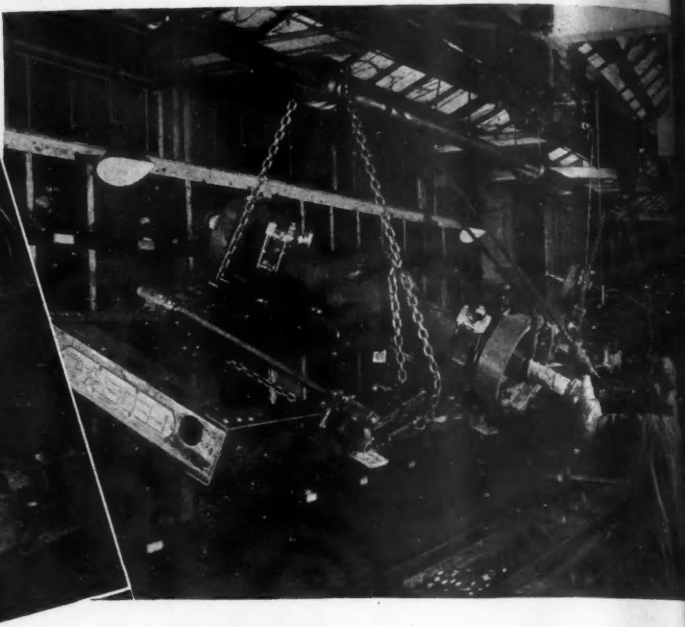
Perhaps the largest production department at Federal is the wood-working shop which builds all the cabs, special bodies, forward-mounted cabs, and camp trailers. Bodies are of composite construction and all feature a sturdy wood structure built up from well machined and jig fitted wood parts. This shop is fully equipped with various types of wood-working machinery and provided with a number of assembly lines for the various operations. An important part of the equipment found here are the many massive framing bucks and jigs, used for building the various sub-assemblies and complete assemblies for cabs and bodies.

A sheet metal department is equipped to handle the forming and finishing of all stampings, including radiator shells, cowls, hoods, dash panels, running boards, and cab and body panels. There are several large presses for drawing larger stampings such as doors and the all-steel tops for the new cabs. Of the larger presses, one is a Toledo No. 95E, rated 250 tons; the other is a welded steel frame hydraulic press of 300 tons capacity which was designed and built in the plant.

We were particularly impressed with the ingenuity exercised by the press shop management in die construction for small runs. Take steel tops for example. For small runs or for special orders they have built, on several occasions, complete die sets made of wood. The quality of the stampings produced by these dies is surprising and we were told that some of the dies are good for as many as 4000 stampings without requiring maintenance.

Assembly operations start with the frame assembly which is hot-riveted and then fitted with the various attachment

In the early stages of chassis assembly the massive Federal frames are mounted upside down on the conveyor. This view shows the unique roll-over mechanism used for rolling the chassis right side up after the underbody units have been installed.



(Upper Left) Herrington multiple spindle drill press is set up for drilling 10 holes simultaneously in the bell housing.

To facilitate paint-spraying of various sheet metal assemblies, Federal has built this interesting merry-go-round machine which simplifies the handling of even large awkward units such as the shroud. The spray booth in the background is provided with a separate set of guns for each of the standard colors.

brackets. The frame is then placed, upside down, on the chassis conveyor and proceeds through the different stages of assembly.

It is interesting to note that the chassis conveyor line extends some 600 ft. of straight length from the first operation to the end of the line. All truck models in the Federal line go over the same conveyor. After attachment of the underframe gear such as springs and axles, the chassis is turned rightside up by means of a unique overhead roll-over fixture and is ready to receive the other units such as engine, wheels, steering gear, and finally the cab and sheet metal.

Following the best modern practice in assembly plants, the numerous sub-assembly stations and banks of stock are located at points of usage at the side of the assembly conveyor. Perhaps the largest of these stations is the motor and transmission assembly where the stock engines are fitted with specified attachments and then the powerplant assembly completed by attachment of the transmission. Another of the large sub-assembly stations takes care of the cowl and instrument board assembly at the point of usage.

Adequate facilities have been provided for finishing and painting the cabs and sheet metal parts made here. Cabs are painted in spray booths located on the second floor body shop while the other sheet metal parts are finished on the main floor. A novel spray booth arrangement has been developed for fin-

One of the largest and most important sub-assembly stations directly off the main assembly line is the motor assembly shown here. Stock engines, stored at this point, are fitted with accessories and attachments and assembled with transmission units according to customer's specifications.

Toledo No. 95E press, rated 250 tons capacity, is one of a group of large presses used here. The operation in this set-up is that of forming door panels.

ishing hoods, radiator shells, and similar parts, utilizing an overhead merry-go-round fixture from which these parts are suspended.

At the end of the chassis assembly line, the trucks are driven off under their own power and enter the inspection department. Here each chassis is run-in on chassis rolls and then inspected in detail by a crew of specially trained mechanics.

In the final stages of assembly, the chassis move under the body drop from the body shop overhead and are fitted with bodies, fenders, lamps, and other equipment.

Trucks for export are built and tested in the usual way over the same assembly lines. Then after the final inspection, they are partially dis-assembled and carefully boxed for export shipment.

The foregoing covers very briefly a high-spotting of the production departments in the Federal factory. For a visual impression of this operation, we refer you to a comprehensive pictorial section containing views from many of the major departments and assembly line stations.

This 300-ton hydraulic press is of all-welded construction and was designed and built by Federal. It is used principally for drawing the steel tops for standard and de luxe cabs.

Financial Analysis of Motor

All figures in the following tables have 000

U. S. Registrations of New Vehicles

	1929	1932	1933	1934	1935	1936
General Motors	1,290,826	515,468	745,437	809,882	1,219,426	1,671,196
Chrysler Corp	373,444	200,087	413,967	480,570	691,391	939,599
Total	1,664,270	715,555	1,159,404	1,290,452	1,910,817	2,610,795
Autocar	2,941	1,009	1,127	1,139	1,001	1,451
Auburn	18,652	11,981	5,038	5,536	5,163	3,022
Brockway Motor Co., Inc.	4,533	812	875	1,213	1,245	1,695
Diamond T	3,590	2,239	4,132	5,440	6,454	8,750
Federal	2,853	1,167	1,360	1,962	2,190	2,930
Graham	60,487	12,858	10,128	12,887	15,965	16,439
Hudson	254,029	37,419	38,777	60,334	76,063	101,201
Hupp	44,337	10,794	6,726	6,566	7,450	1,556
International	31,434	15,676	26,658	31,555	53,471	71,958
Mack	6,823	1,421	1,652	1,830	1,515	4,226
Nash	105,146	20,233	11,353	23,616	35,184	43,070
Packard	44,634	11,058	9,081	6,552	37,653	68,772
Reo	30,213	7,053	6,398	8,889	8,995	7,373
Studebaker	92,886	47,085	38,243	43,257	41,673	71,114
White	6,121	2,138	1,384	3,963	4,166	7,462
Willys-Overland	206,245	27,026	15,900	6,601	12,719	14,864
Yellow Truck and Coach	14,248	6,349	6,602	10,449	11,442	26,980
Total	929,172	216,318	185,434	231,789	322,349	452,863
Grand Total	2,593,442	931,873	1,344,838	1,522,241	2,233,166	3,063,658

† Year ending August 31, 1929.

Sales Volume

	1929	1932	1933	1934	1935	1936
General Motors	$1,504,404	$432,312	$569,011	$862,673	$1,155,642	$1,439,290
Chrysler Corp	375,033	136,547	238,676	362,255	516,830	667,138
Total	$1,879,437	$568,859	$807,687	$1,224,928	$1,672,472	$2,106,428
Autocar	15,695	6,438	6,264	7,294	7,966	11,688
Auburn	37,551	12,916	5,405	10,406	9,308	8,384
Brockway Motor Co., Inc.	20,420	....	....	....	....	....
Diamond T	....	....	5,536	8,210	9,957	14,436
Federal	9,293	....	....	4,884	....	....
Graham	64,490	....	8,333	11,595	14,622	15,635
Hudson	201,018	25,862	23,521	52,568	63,077	77,151
Hupp	52,506	8,751	6,119	7,196	6,868	416
International	....	....	....	138,312	217,583	254,934
Mack	57,227	13,218	15,744	18,346	20,211	30,795
Nash	108,860	15,331	8,984	19,671	27,812	30,966
Packard	†107,542	15,516	19,230	14,619	49,966	73,053
Reo	48,011	9,096	10,260	13,836	16,136	....
Studebaker	145,304	46,234	35,994	40,156	33,838	68,929
White	48,653	17,117	13,615	20,540	19,908	28,770
Willys-Overland	159,811	13,977	....	....	....	....
Yellow Truck and Coach	49,908	16,438	19,668	28,250	35,857	59,426
Total	$1,126,289	$200,894	$178,673	$395,883	$533,109	$674,583
Grand Total	$3,005,726	$769,753	$986,360	$1,620,811	$2,205,581	$2,781,011

Net Income

	1929	1932	1933	1934	1935	1936
General Motors	$245,970	$ 165	$83,214	$94,769	$167,431	$238,705
Chrysler Corp	21,902	*d*11,254	12,129	9,535	34,976	62,111
Total	$267,872	*d*$11,089	$95,343	$104,304	$202,407	$300,816
Autocar	854	*d*1,078	*d*317	*d*140	*d*165	164
Auburn	3,603	*d*975	*d*2,308	*d*3,642	*d*2,698	*d*1,523
Brockway Motor Co., Inc.	290	....	25	34	61	....
Diamond T	....	....	241	397	446	721
Federal	502	*d*631	*d*165	36	144	185
Graham	*d*1,464	*d*2,811	67	*d*475	*d*1,701	*d*470
Hudson	11,595	*d*5,429	*d*4,410	*d*3,239	585	3,306
Hupp	3,469	*d*4,515	*d*1,778	*d*4,398	*d*2,607	*d*1,079
International	36,780	*d*7,583	*d*1,886	3,949	19,619	29,760
Mack	6,841	*d*1,480	*d*950	17	*d*396	1,441
Nash	18,014	1,029	*d*1,189	*d*1,625	*d*610	1,021
Packard	25,183	*d*6,824	107	*d*7,291	3,316	7,053
Reo	1,074	*d*2,879	*d*1,491	*d*958	*d*220	....
Studebaker	11,928	*d*8,687	*d*4,876	*d*1,462	*d*1,076	‡2,188
White	2,548	*d*3,619	*d*3,413	*d*1,401	*d*2,912	682
Willys-Overland	*d*4,980	*d*6,628	....	*d*7,091	....	....
Yellow Truck and Coach	1,178	*d*3,787	*d*982	*d*886	503	5,089
Total	$117,415	*d*$55,897	*d*$23,325	*d*$28,175	$11,389	$48,538
Grand Total	$385,287	*d*$66,986	$72,018	$76,129	$213,796	$349,354

d Deficit

Common and Preferred Dividends

	1929	1932	1933	1934	1935	1936
General Motors	$165,954	$63,199	$63,005	$73,622	$105,649	$202,082
Chrysler Corp	13,336	4,390	4,304	5,432	8,665	52,191
Total	$179,290	$67,589	$67,309	$79,054	$114,314	$254,273
Autocar	74	....	....	....	....	8
Auburn	645	835	553	223	....	....
Brockway Motor Co., Inc.	635	....	....	....	....	....
Diamond T	....	....	77	181	139	423
Federal	400	....	....	....	100	....
Graham	372	30	....	....	....	....
Hudson	8,180	....	....	....	....	....
Hupp	2,760	....	....	....	....	....
International	16,466	12,047	8,242	8,264	8,865	16,281
Mack	4,534	692	665	650	600	896
Nash	16,380	4,095	1,985	1,985	2,646	2,647
Packard	17,234	....	....	....	....	6,746
Reo	2,400	....	....	....	....	....
Studebaker	10,037	992	....	....	....	....
White	1,000	3,125	....	....	....	....
Willys-Overland	3,757	....	....	....	....	....
Yellow Truck and Coach	635	....	....	....	....	5,039
Total	$85,509	$21,816	$11,522	$11,303	$12,350	$32,040
Grand Total	$264,799	$89,405	$78,831	$90,357	$126,664	$286,313

Cash and Securities

	1929	1932	1933	1934	1935	1936
General Motors	$127,352	$172,781	$177,304	$186,967	$199,436	$195,658
Chrysler Corp	38,706	42,603	37,370	32,416	59,118	60,904
Total	$166,058	$215,384	$214,674	$219,383	$258,554	$256,562
Autocar	1,787	538	528	545	404	421
Auburn	2,082	5,138	3,983	1,115	511	969
Brockway Motor Co., Inc.	1,422	63	395	471	249	....
Diamond T	149	149	195	257	679	378
Federal	1,427	978	624	675	747	701
Graham	6,180	528	707	523	306	608
Hudson	17,145	4,199	2,680	2,576	9,584	12,037
Hupp	10,156	4,904	3,585	1,035	63	132
International	25,884	56,869	61,831	63,118	87,340	52,028
Mack	1,899	9,768	7,766	5,062	3,256	2,257
Nash	42,011	32,135	29,915	27,257	24,521	22,774
Packard	17,910	13,995	13,387	15,161	12,986	14,358
Reo	9,563	5,972	1,480	2,427	....	....
Studebaker	5,438	9,309	2,611	2,039	5,160	7,130
White	10,657	7,762	5,836	2,508	1,757	2,187
Willys-Overland	925	137	....	617	....	....
Yellow Truck and Coach	5,900	4,205	4,155	2,711	5,216	8,340
Total	$160,535	$156,649	$139,678	$128,097	$152,779	$124,320
Grand Total	$326,593	$372,033	$354,352	$347,480	$411,333	$380,882

Inventories

	1929	1932	1933	1934	1935	1936
General Motors	$188,473	$75,479	$115,585	$138,598	$196,325	$225,645
Chrysler Corp	38,102	18,377	34,557	37,534	48,766	60,565
Total	$226,575	$93,856	$150,142	$176,132	$245,091	$286,210
Autocar	3,706	1,968	2,202	1,951	2,160	2,506
Auburn	8,754	4,011	2,780	3,194	2,780	2,211
Brockway Motor Co., Inc.	5,161	8	1,116	884	1,069	....
Diamond T	1,282	567	781	1,043	967	1,443
Federal	2,556	1,388	1,512	1,460	1,410	1,567
Graham	7,343	1,410	1,052	1,289	1,718	1,612
Hudson	13,467	3,615	4,492	4,562	4,885	8,006
Hupp	8,481	2,115	1,736	1,495	615	657
International	102,295	76,348	85,690	92,268	98,244	116,829
Mack	20,306	9,047	8,694	8,484	8,400	9,441
Nash	5,246	1,023	2,077	2,138	2,733	5,620
Packard	13,624	5,763	5,451	4,777	8,109	9,965
Reo	10,051	3,454	3,310	3,905	....	....
Studebaker	26,083	17,410	5,069	6,010	6,405	7,756
White	15,566	8,397	7,981	8,848	9,089	9,549
Willys-Overland	18,070	2,788	....	717	....	....
Yellow Truck and Coach	11,142	8,341	10,518	11,415	11,483	15,338
Total	$273,133	$147,653	$144,461	$154,440	$160,067	$192,500
Grand Total	$499,708	$241,509	$294,603	$330,572	$405,158	$478,710

Vehicle Manufacturers, 1929-1936

omitted and therefore represent thousands of dollars

Current Assets

	1929	1932	1933	1934	1935	1936
General Motors	$368,961	$279,978	$317,515	$365,844	$465,028	$513,986
Chrysler Corp	90,313	65,682	74,640	87,089	128,204	140,102
Total	$459,274	$345,660	$392,155	$452,933	$593,232	$654,088
Autocar	8,012	4,537	4,276	4,479	4,874	6,082
Auburn	13,327	10,898	8,549	5,681	3,866	3,599
Brockway Motor Co., Inc.	9,308	....	2,645	2,669	2,708	....
Diamond T	2,913	1,128	1,668	2,009	2,157	2,577
Federal	5,685	2,735	2,481	2,527	2,531	2,600
Graham	14,554	2,163	1,891	1,960	2,486	2,504
Hudson	34,474	8,666	7,533	7,883	16,279	21,774
Hupp	19,882	7,283	5,661	2,874	1,270	857
International	265,505	232,979	232,329	225,569	253,379	284,486
Mack	44,293	29,205	26,695	23,378	22,597	27,982
Nash	53,141	34,145	33,191	30,156	28,626	30,043
Packard	38,080	20,450	22,252	18,656	24,851	29,792
Reo	22,688	9,984	7,887	7,147	....	....
Studebaker	36,028	33,234	9,589	9,884	13,536	16,393
White	32,197	19,411	16,784	15,096	13,772	15,945
Willys-Overland	27,598	3,525	....	....	....	....
Yellow Truck and Coach	22,050	15,368	15,208	14,969	17,848	30,114
Total	$649,735	$435,711	$398,639	$374,937	$410,780	$474,748
Grand Total	$1,109,009	$781,371	$790,794	$827,870	$1,004,012	$1,128,836

Current Liabilities

	1929	1932	1933	1934	1935	1936
General Motors	$117,673	$57,822	$76,183	$90,199	$145,067	$174,300
Chrysler Corp	18,928	16,395	21,223	37,686	66,901	75,132
Total	$136,601	$74,217	$97,406	$127,885	$211,968	$249,432
Autocar	2,603	869	922	1,172	1,600	2,520
Auburn	3,296	330	618	649	1,941	1,003
Brockway Motor Co., Inc.	3,858	....	281	290	298	....
Diamond T	1,278	277	638	832	1,012	1,384
Federal	572	166	238	340	345	421
Graham	2,984	1,297	995	1,463	2,383	1,746
Hudson	8,271	2,200	4,461	6,138	6,704	9,794
Hupp	2,541	1,074	1,107	676	779	545
International	43,586	16,702	19,506	22,387	33,285	44,009
Mack	7,209	1,667	1,905	1,784	2,436	5,566
Nash	8,860	1,145	2,312	1,407	2,537	4,005
Packard	13,204	2,325	2,330	4,695	6,554	11,543
Reo	2,717	849	955	1,106	....	....
Studebaker	9,988	11,453	3,832	5,821	6,777	5,271
White	3,176	1,096	1,598	1,369	2,140	2,733
Willys-Overland	5,910	5,942	....	....	....	....
Yellow Truck and Coach	3,013	1,461	1,995	2,306	3,708	7,442
Total	$123,066	$48,853	$43,693	$52,435	$72,499	$97,982
Grand Total	$259,667	$123,070	$141,099	$180,320	$284,467	$347,414

Working Capital

	1929	1932	1933	1934	1935	1936
General Motors	$251,288	$222,156	$241,332	$275,646	$319,961	$339,687
Chrysler Corp	71,385	49,286	53,417	49,402	61,303	64,970
Total	$322,673	$271,442	$294,749	$325,048	$381,264	$404,657
Autocar	5,409	3,669	3,354	3,307	3,090	3,562
Auburn	10,031	10,568	7,930	5,032	1,925	2,595
Brockway Motor Co., Inc.	5,449	....	2,364	2,379	2,410	....
Diamond T	1,635	851	1,030	1,177	1,145	1,193
Federal	5,113	2,569	2,243	2,187	2,186	2,179
Graham	11,099	866	896	498	103	758
Hudson	26,203	6,466	3,072	2,138	9,967	11,979
Hupp	17,342	6,209	4,554	2,198	492	312
International	221,919	216,277	212,822	203,183	220,094	240,478
Mack	37,084	27,538	24,790	21,594	20,161	22,416
Nash	44,281	33,000	30,879	28,748	26,089	26,038
Packard	24,876	18,125	19,922	13,961	18,297	18,249
Reo	19,972	9,135	6,932	6,042	6,485	5,289
Studebaker	25,785	21,781	5,757	4,063	6,759	11,122
White	29,021	18,315	15,186	13,727	11,632	13,212
Willys-Overland	21,688	2,416	....	....	....	....
Yellow Truck and Coach	19,036	13,907	13,285	12,663	14,140	....
Total	$525,943	$391,692	$355,016	$322,897	$344,975	$359,382
Grand Total	$848,616	$663,134	$649,765	$647,945	$726,239	$764,039

Plant and Property—Depreciated

	1929	1932	1933	1934	1935	1936
General Motors	$415,785	$328,274	$303,765	$305,678	$319,178	$388,211
Chrysler Corp	83,624	61,697	60,409	59,356	53,577	60,229
Total	$499,409	$389,971	$364,174	$365,034	$372,755	$448,440
Autocar	3,534	3,330	3,206	3,128	3,085	2,997
Auburn	7,075	7,343	6,732	6,216	5,454	5,391
Brockway Motor Co., Inc.	1,719	949	159	170	190	....
Diamond T	384	397	363	396	677	681
Federal	1,498	1,240	1,165	1,136	1,152	1,166
Graham	13,987	6,640	6,340	5,020	4,638	3,660
Hudson	33,276	25,614	24,440	22,567	20,972	20,008
Hupp	16,407	8,463	7,843	7,224	3,752	3,966
International	115,343	111,750	107,320	104,341	103,213	105,706
Mack	20,506	16,643	16,091	16,045	15,812	14,962
Nash	9,161	6,029	5,413	4,376	3,812	5,372
Packard	37,870	31,319	29,117	27,842	27,008	27,375
Reo	10,689	4,646	3,899	3,893	3,636	3,361
Studebaker	59,077	58,513	49,801	49,829	14.862	13,516
White	9,634	7,942	7,407	10,092	8,856	8,299
Willys-Overland	39,135	32,072	....	18,389	....	....
Yellow Truck and Coach	14,765	15,249	15,261	15,354	15,430	18,667
Total	$394,060	$338,139	$284,557	$296,018	$232,549	$235,127
Grand Total	$893,469	$728,110	$648,731	$661,052	$605,304	$683,567

Capital Stock *(Includes Preferred and Common)*

	1929	1932	1933	1934	1935	1936
General Motors	$571,924	$622,537	$622,537	$622,537	$622,537	$622,537
Chrysler Corp	73,756	21,847	21,807	21,729	21,662	21,792
Total	$645,680	$644,384	$644,344	$644,266	$644,199	$644,329
Autocar	7,479	3,562	3,562	3,562	3,562	1,574
Auburn	7,993	10,714	10,946	10,946	10,946	11,034
Brockway Motor Co., Inc.	5,468	5,468	1,000	1,000	1,000	....
Diamond T	873	873	873	873	873	706
Federal	2,498	2,498	2,498	2,498	2,498	2,498
Graham	14,004	3,788	3,783	3,036	2,921	3,289
Hudson	19,958	19,958	19,958	19,958	19,958	19,958
Hupp	14,754	13,291	13,291	13,291	13,186	13,186
International	255,067	252,156	251,425	251,504	251,503	251,503
Mack	3,900	3,381	3,337	3,137	2,987	2,987
Nash	13,887	13,887	13,887	13,887	13,887	13,887
Packard	50,000	40,000	40,000	40,000	30,000	30,000
Reo	20,000	9,000	9,000	9,000	9,000	9,000
Studebaker	85,424	59,727	55,094	55,094	2,152	2,172
White	40,000	31,250	31,250	31,250	31,250	31,250
Willys-Overland	29,601	27,621	....	27,621	....	....
Yellow Truck and Coach	36,000	36,000	36,000	36,000	36,000	17,398
Total	$606,906	$533,174	$495,904	$522,657	$431,723	$410,442
Grand Total	$1,252,586	$1,177,558	$1,140,248	$1,166,923	$1,075,922	$1,054,771

Surplus *(Includes Capital Surplus where given)*

	1929	1932	1933	1934	1935	1936
General Motors	$380,560	$238,232	$248,961	$270,109	$331,680	$368,081
Chrysler Corp	54,087	52,695	60,043	64,094	90,331	101,528
Total	$434,647	$290,927	$309,004	$334,203	$422,011	$469,609
Autocar	1,096	2,735	2,262	2,122	1,957	4,056
Auburn	6,210	4,859	1,738	*d*1,930	*d*4,757	*d*6,289
Brockway Motor Co., Inc.	1,656	*d*6,936	255	288	349	....
Diamond T	1,260	441	587	800	1,107	1,327
Federal	3,714	1,512	1,347	1,274	1,287	1,276
Graham	8,570	2,071	2,199	2,553	1,018	1,665
Hudson	38,726	11,686	7,276	4,036	5,104	8,409
Hupp	18,942	2,013	236	*d*3,146	*d*7,495	*d*8,729
International	50,074	45,066	44,938	40,622	51,376	64,993
Mack	54,761	41,490	39,744	38,387	36,807	37,352
Nash	39,771	26,301	23,793	20,467	17,695	19,048
Packard	15,584	8,398	8,905	1,614	14,930	15,237
Reo	10,834	5,284	2,718	1,940	1,494	....
Studebaker	30,562	20,697	7,278	5,615	14,322	16,673
White	8,678	2,088	*d*1,081	*d*2,264	*d*6,176	*d*5,709
Willys-Overland	30,180	400	....	....	....	....
Yellow Truck and Coach	989	*d*4,445	*d*5,428	*d*6,314	*d*5,811	21,694
Total	$321,607	$163,660	$136,767	$106,064	$123,207	$171,003
Grand Total	$756,254	$454,587	$445,771	$440,267	$545,218	$640,612

d—Deficit

Financial Analysis of Motor Vehicle Manufacturers, 1929-1936—*Continued*

(Thousands of Dollars)

Capital and Surplus

	1929	1932	1933	1934	1935	1936
General Motors	$952,484	$860,769	$871,498	$892,646	$954,217	$990,618
Chrysler Corp	127,843	74,542	81,850	85,823	111,993	123,320
Total	$1,080,327	$935,311	$953,348	$978,469	$1,066,210	$1,113,938
Autocar	8,575	6,297	5,824	5,684	5,519	5,630
Auburn	14,230	15,573	12,684	9,016	6,189	4,745
Brockway Motor Co., Inc.	7,124	*d*1,468	1,255	1,288	1,349	....
Diamond T	2,133	1,314	1,460	1,673	1,980	2,033
Federal	6,212	4,010	3,845	3,772	3,785	3,774
Graham	22,574	5,859	5,982	5,589	3,939	4,954
Hudson	58,684	31,644	27,234	23,994	25,062	28,367
Hupp	33,696	15,304	13,527	10,145	5,691	4,457
International	305,141	297,222	296,363	210,882	302,879	316,496
Mack	58,661	44,871	43,081	41,524	39,794	40,339
Nash	53,658	40,188	37,680	34,354	31,582	32,935
Packard	65,584	48,398	48,905	41,614	44,930	45,237
Reo	30,834	14,284	11,718	10,940	10,494	....
Studebaker	115,986	80,424	62,372	60,709	16,474	18,845
White	48,678	33,338	30,169	28,986	25,074	25,541
Willys-Overland	59,781	28,021	....	27,621	....	....
Yellow Truck and Coach	36,989	31,555	30,572	29,686	30,189	....
Total	$928,540	$696,834	$632,671	$547,477	$554,930	$533,353
Grand Total	$2,008,867	$1,632,145	$1,586,019	$1,525,946	$1,621,140	$1,647,291

Good Will, Patents, etc.

	1929	1932	1933	1934	1935	1936
General Motors	$50,680	$51,839	$51,838	$51,838	$50,326	$50,325
Chrysler Corp	25,000	....	....	....	....	....
Total	$75,680	$51,839	$51,838	$51,838	$50,326	$50,325
Autocar	....	....	....	....	....	....
Auburn	....	....	....	....	....	....
Brockway Motor Co., Inc.	....	....	....	....	....	....
Diamond T	90	90	90	90	90	5
Federal	....	....	....	....	....	....
Graham	....	....	....	....	....	....
Hudson	....	....	....	....	....	....
Hupp	....	....	....	....	....	....
International	....	....	....	....	....	....
Mack	2,438	2,438	2,438	2,438	2,438	2,438
Nash	....	....	....	....	....	....
Packard	....	....	....	....	....	....
Reo	....	....	....	....	....	....
Studebaker	....	....	....	....	....	....
White	5,389	5,389	5,389	5,389	5,389	5,389
Willys-Overland	....	....	....	....	....	....
Yellow Truck and Coach	....	....	....	....	....	....
Total	$7,917	$7,917	$7,917	$7,719	$7,719	$7,832
Grand Total	$83,597	$59,756	$59,755	$59,755	$58,243	$58,157

Capital and Surplus Less Good Will, etc.

	1929	1932	1933	1934	1935	1936
General Motors	$901,804	$808,930	$819,660	$840,808	$903,891	$940,293
Chrysler Corp	102,843	74,542	81,850	85,823	111,993	123,320
Total	$1,004,647	$883,472	$901,510	$926,631	$1,015,884	$1,063,613
Autocar	8,575	6,297	5,824	5,684	5,519	5,630
Auburn	14,230	15,573	12,684	9,016	6,189	4,745
Brockway Motor Co., Inc.	7,124	*d*1,468	1,255	1,288	1,349	....
Diamond T	2,043	1,224	1,370	1,583	1,890	2,028
Federal	6,212	4,010	3,845	3,772	3,785	3,774
Graham	22,574	5,859	5,982	5,589	3,939	4,954
Hudson	58,684	31,644	27,234	23,994	25,062	28,367
Hupp	33,696	15,304	13,527	10,145	5,691	4,457
International	305,141	297,222	296,363	210,882	302,879	316,496
Mack	56,223	42,433	40,643	39,086	37,356	37,901
Nash	53,658	40,188	37,680	34,354	31,582	32,935
Packard	65,584	48,398	48,905	41,614	44,930	45,237
Reo	30,834	14,284	11,718	10,940	10,494	....
Studebaker	115,986	80,424	62,372	60,709	16,474	18,845
White	43,289	27,949	24,780	23,597	19,685	20,152
Willys-Overland	59,781	28,021	....	27,621	....	....
Yellow Truck and Coach	36,989	31,555	30,572	29,686	30,189	....
Total	$920,623	$688,917	$624,754	$539,560	$547,013	$525,521
Grand Total	$1,925,270	$1,572,389	$1,526,264	$1,466,191	$1,562,897	$1,589,134

Funded Debt, Bonds, Debentures, etc.

	1929	1932	1933	1934	1935	1936
General Motors	$1,992	$........	$........	$........	$........	$........
Chrysler Corp	49,765	42,331	40,027	30,150	....	....
Total	$51.757	$42,331	$40,027	$30,150	....	....
Autocar	1,395	1,008	1,024	1,020	1,015	1,010
Auburn	512	131	98	....	....	2,309
Brockway Motor Co., Inc.	225	100	1,001	1,001	1,001	....
Diamond T	....	....	....	....	....	....
Federal	686	....	....	....	....	....
Graham	3,125	1,805	1,567	1,336	1,686	963
Hudson	....	....	....	....	5,750	3,850
Hupp	....	....	....	....	....	....
International	....	....	....	....	....	....
Mack	2,200	541	....	....	....	....
Nash	....	....	....	....	....	....
Packard	....	....	....	....	....	....
Reo	....	....	....	....	....	....
Studebaker	....	15,759	15,129	15,126	6,841	6,815
White	42	....	....	949	773	583
Willys-Overland	4,000	2,000	....	2,000	....	....
Yellow Truck and Coach	....	....	....	....	....	....
Total	$12,185	$21,344	$18,894	$21,431	$17,066	$15,530
Grand Total	$63,942	$63,675	$58,921	$51,581	$17,066	$15,530

Notes:

1. The Brockway Motor Truck Corp. on September 1, 1932, transferred all of its operating assets to Brockway Motor Co., Inc., the latter company assuming all current debts, liabilities, etc. The Brockway Motor Truck Corp. owns all stock and debentures of the Brockway Motor Co., Inc. In this financial analysis the data shown for 1929 and 1932 are for the Brockway Motor Truck Corp. Subsequent yearly data are for the Brockway Motor Co., Inc.

2. Studebaker Corporation (of New Jersey) acquired the White Motor Company, October 18, 1932. On August 26, 1933, the Pierce-Arrow interests were sold. These interests had been acquired in August, 1928. The balance sheets for 1929 and 1932 include the Pierce-Arrow and White Motor Company.

The Studebaker Corporation (of New Jersey) went into receivership March 18, 1933, and remained in that state until March 8, 1935. The Studebaker Corporation (of Delaware) began business March 9, 1935. Data shown in these tables for the year 1935 are for that period from March 9 to December 31 inclusive. The 1934 report is based on the statement as put out by the receivers.

3. The Willys-Overland Company went into receivership on Feb. 15, 1933, John N. Willys and L. A. Miller acting as receivers. On Feb. 25, 1936, the receivership was dissolved and D. R. Wilson was appointed trustee to operate the company under Corporate Bankruptcy Act proceedings. Mr. Wilson was also appointed president and director by action of the board.

The statement as given for 1934 is that as filed by the receivers of the company. The first interim statement of Willys-Overland Motors, Inc., the new company, has just been published. It covered the six months ended March 31, 1937.

4. Yellow Truck & Coach do not report the depreciated value of their plant and property account.

5. The Autocar surplus account for 1935 is net after earned surplus deficit.

Gains Presaged in 1936 Reports

(Continued from page 828)

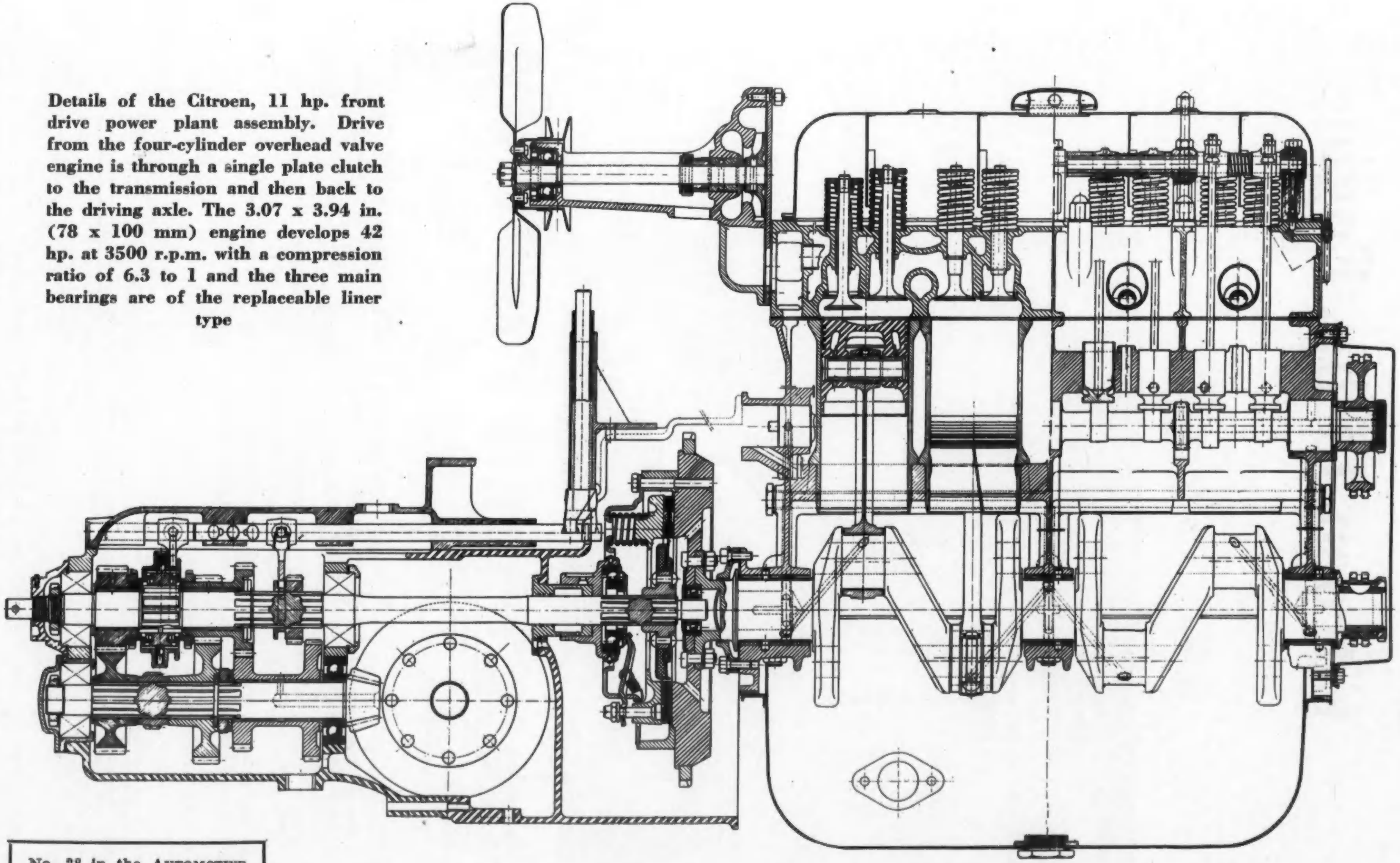
the average payroll. Where current liabilities declined, it was the result, in some cases, of reduction of borrowings, which also reduced cash.

The net result of the changes in current position resulted in a considerable number of increased working capital tabulations, with exceptions for the reasons given above. In the aggregate, the ratio of current assets to current liabilities fell slightly, but the companies involved were very well financed as a whole.

There was very little change in capitalizations. Due to some readjustments downward in connection with recapitalizations that were intended to wipe out balance sheet deficits to enable dividend resumptions, aggregate capital account was down. Total surplus showed an increase, even after the heavy dividend payments, due in part to the bookkeeping increases in some capital surplus accounts as a result of the recapitalizations.

Funded debt was reduced in several of the few cases where it existed. Generally, the automobile industry is not financed through issuance of debt. Those companies which used bank loans to finance elimination of funded debt have since paid off part or all of the loans.

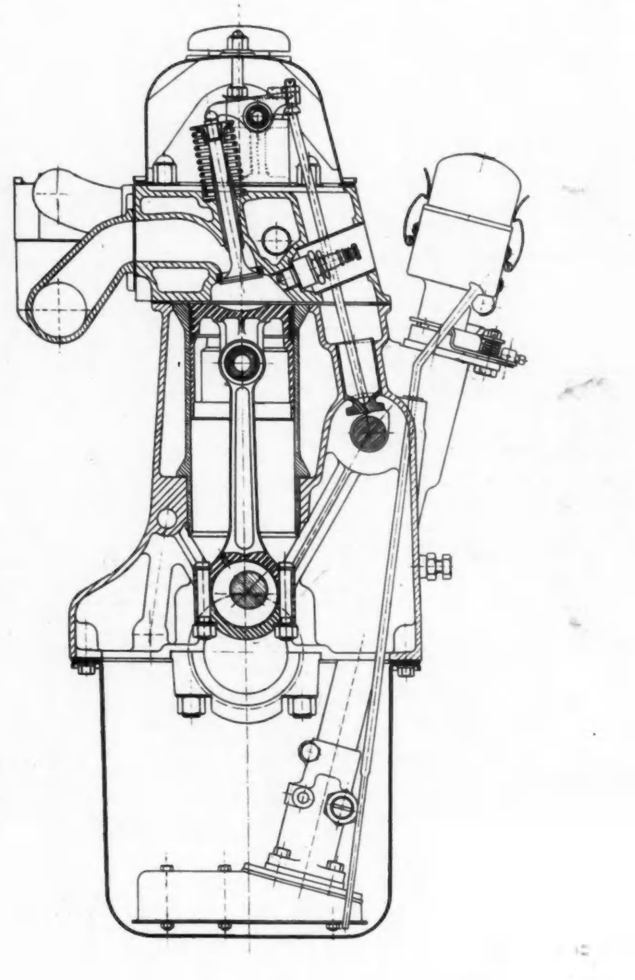
Citroen 11 hp. Engine for Front Wheel Drive



Details of the Citroen, 11 hp. front drive power plant assembly. Drive from the four-cylinder overhead valve engine is through a single plate clutch to the transmission and then back to the driving axle. The 3.07 x 3.94 in. (78 x 100 mm) engine develops 42 hp. at 3500 r.p.m. with a compression ratio of 6.3 to 1 and the three main bearings are of the replaceable liner type

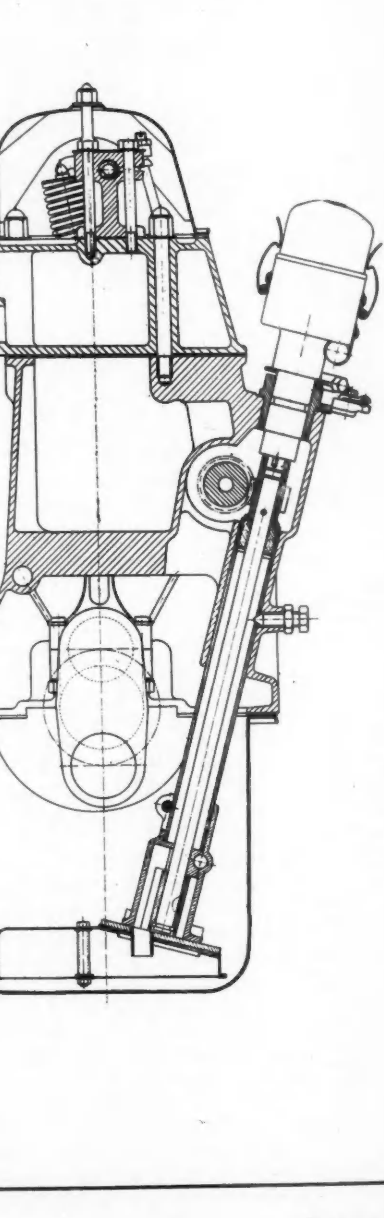
No. 28 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings

Citroen 11 hp. Engine



The chain driven camshaft is mounted unusually high, being nearly closer to the top of the block than to the center line of the crankshaft. Both valves and push rods are on an extreme angle

Cylinders are of the wet sleeve type. Note the contour of the aluminum alloy piston heads. Cylinder heads are of cast iron, with inserts for the exhaust valves



Car Output to Hold Well

(Continued from page 825)

the corresponding period of 1936, indicating an increase of better than 10 per cent. The gain over the first quarter amounts to more than 25 per cent. The first quarter of 1937 showed an increase of 16.6 per cent over the like period in 1936, but the first 6 months of this year will be up only about 13 per cent over the corresponding period last year.

Sales figures for the final ten days of May have not been reported to the factories, but such weekly figures as are available show no slackening in demand. With the sales of so many companies right on the heels of production because of the lack of usual reserves in the field, it is not unlikely that deliveries in the final ten days will reflect the reduction in output since that period had only six working days, compared with eight in the preceding 10-day sales period. At any rate, the retail volume for the month is expected to approximate 500,000 units or just about the number of vehicles produced for the domestic market.

New car stocks on the whole were no larger at the end of May than at the end of April when they were far below normal.

Hupp Plans August Showing

Hupp Motor Car Corp., desirous of being the first manufacturer to reach the market with 1938 models, will probably be in production sometime in July. The company has given the contract for all its passenger car bodies and tools and dies to the Hayes Body Corp. The contract amounts to over $1,000,000 for the first year of Hupmobile operations. Hayes Body built Hupmobile bodies in the past. Hupp plans call for announcement as early in August as possible.

Graham Announces Convertible

Graham-Paige Motors Corp. is now offering a new convertible coupe available on the Custom Supercharger, the Supercharger and Cavalier 116-in. chassis. Following substantially the lines of the regular Graham coupes, the new convertible embodies several new developments in body construction.

The special V-type windshield is fixed permanently in place and slants back toward the top. The frame of the windshield wing is also fixed and remains in place regardless of the position of the top. The overall height of the top is several inches less than that of the regular coupes.

Used Car Turnover Speeded

A sales promotion campaign by Cadillac-LaSalle has had the following three results, reported D. E. Ahrens, sales manager; average turnover rate on trade-ins has been cut from 49 to 26 days, a used car inventory below the peak of Winter months in spite of record new car movement, and increases in used car sales of as much as 100 per cent for some ten day periods.

Time Sales Large in 1935

Motor vehicle dealers, exclusive of used car dealers, did 59.9 per cent of their business on the instalment plan in 1935, according to the Bureau of the Census. For the same year these dealers did 10 per cent of their business on open account and 30.1 per cent for cash. The report was based on the detailed data available covering 42.9 per cent of the total sales of new car dealers.

Pyrene Offers New Line

Heavy vehicle type Pyrene fire extinguishers with special "shock absorber" construction withstand excessive vibration and fitted with steel brackets in two styles for truck and bus equipment are announced by Pyrene Manufacturing Company. One bracket is for mounting the extinguisher on the steering post and the other for any position on the dash or inside of cab.

Auto Lite Sells Units

Electric Auto-Lite Co. has sold three small subsidiaries in a move toward simplification of its capital structure. The purchaser has not been named. The three are the Concealed Doorcheck Co. of Indianapolis, which was a subsidiary of the Prest-O-Lite Co., Barley Industries, Inc., and the Dearhart Doorcheck Co., a subsidiary of Barley, of Detroit. Artificial leather products were included in the list of products handled.

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Diesel Fuels and Oscillograph Studies

Abstracts of papers presented at the S.A.E. Summer Meeting

Diesel Injection Timing Should Vary with the Engine Speed

RESEARCH work on Diesel fuels of different cetane numbers was dealt with in a paper by G. C. Wilson and R. A. Rose of the University of Wisconsin. The tests were made with a cathode-ray oscillograph developed at the university and which was described in a paper presented by Rose, Wilson and Benedict at the 1936 summer meeting.

A few changes were made in the indicating apparatus to overcome minor difficulties. In order to place the pressure pick-up piston right next to the combustion chamber, its cylinder was bored directly in the engine head, and a Midgley-type piston with a very stiff spring was installed to actuate the light shutter. Since the light shutters for both the pressure variation and the nozzle valve stem are necessarily integral with the engine unit, vibration of the engine caused the light beam to dance over the sensitive surface of the photo-cell. An attempt was made to solve the difficulty by mounting the photo-cell rigidly on the shutter housing, but the vibration soon destroyed it. Finally it was found that Visitron photo-cells, types 79-A, were not sensitive to movements of the light beam and could be used successfully when mounted separately from the engine.

The 3¾ by 4½ in. laboratory test engine was modified by removing the plate from the top of the piston to compensate for the volume change resulting from placing the indicator piston adjacent to the combustion chamber. During the tests covered by this paper, the compression ratio was 15.64. A 30-deg. pintle-type nozzle injected the fuel into the open combustion chamber formed in the piston. The nozzle valve was kept adjusted to lift at 3100 lb. per sq. in. for all fuels. The water outlet temperature was kept at 140 deg. F. and the output at 4 hp. at 1250 r.p.m.

Records of injector-valve lift, cylinder pressure and radiation are obtained with the apparatus used. In Fig. 1 is shown a composite picture of all of the radiation curves. It will be observed that all indicate a minimum ignition lag of about 0.001 second. The point at which they leave this line of minimum ignition lag (the break-away point) is approximately in the order of their cetane rating. The engine used had a compression ratio high enough to burn

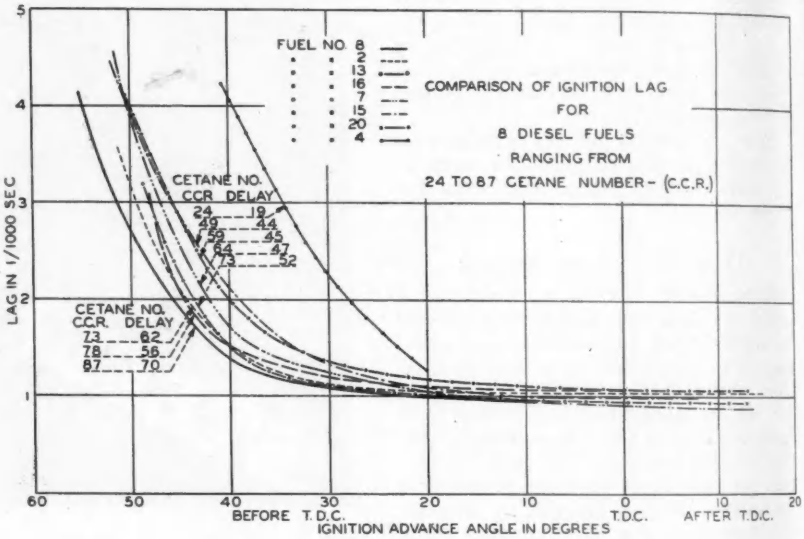

Fig. 1 — (Above) Comparison of ignition lag for eight Diesel fuels ranging from 24 to 87 cetane number (C.C.R.)

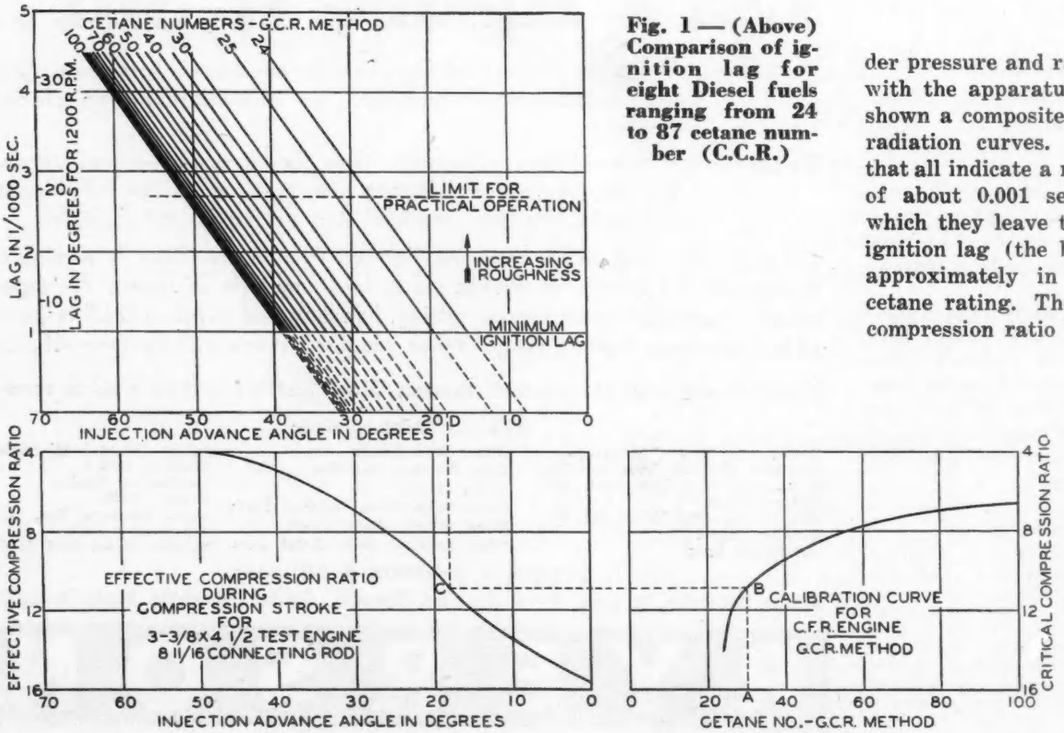

Fig. 2—(Group of three at left) Chart for determining injection angle for smooth Diesel engine operation

fuels of low cetane rating, and the authors point out in this connection that injection of fuel later in the compression stroke is equivalent to injecting it into an engine of a higher compression ratio.

The shape of each curve in Fig. 1 shows a striking resemblance to two straight lines, one of which is practically coincident for all fuels, due to the fact that all of them show practically the same rate of minimum ignition lag. The break-away point comes earlier in the compression stroke for the fuels of higher cetane rating. This leads to a theoretical consideration of reasons which might account for the shape of these curves. The chart shown in Fig. 2 has been derived from a theoretical consideration for the special test engine by combining its effective compression ratio at different crank positions with the cetane value determined by the C. C. R. method. It is surprising to find that the effective compression ratios in the test engine correspond very closely with those of the C. F. R. test engine in which the fuels were rated. The graph at the lower right shows the relation between cetane numbers and critical compression ratio (C.C.R.) for the C. F. R. engine in which the fuels were rated. The lower left curve was constructed by calculating the compression ratio for different positions of the test engine piston as it approaches top dead center. The upper graph shows ignition lag, either in time units or in degrees of crank travel at a speed of 1200 r.p.m., plotted against crank angle. Thus both axes are virtually time axes.

To use the chart of Fig. 2 take any cetane number fuel, say 30 at point *A*, and find the C. C. R. of the C. F. R. engine corresponding to this rating by tracing the path *A* to *B*. Then trace horizontally from *B* to *C* to find the crank position in the special test engine at which the effective compression ratio is the same. The crank angle is found at *D* to be 18 deg., which is the earliest point of advance that a fuel of 30 cetane number will burn with minimum delay. If the fuel is to fire at this point, it must be injected 0.001 second earlier to allow for the minimum ignition lag.

The results of the test showed that all fuels give rough operation if injected as much as, or more than, 0.0027 second before combustion starts. Thus, a low-cetane fuel may burn smoothly, and a high-cetane fuel may burn roughly, depending upon the angle of injection advance. The outstanding cause of ignition delay and engine roughness with low cetane fuels is too early injection of the fuel. The time of beginning of fuel injection should not only vary with the engine speed, but it should be adjustable to suit each different fuel.

Cathode-Ray Oscillograph Use Is Investigated

STUDIES of both linear and torsional vibration in engines by means of the cathode-ray oscillograph, were dealt with in a paper by Sidney Oldberg, Maynard Yeasting and Max M. Roensch, of the Chrysler Corporation, which was presented by Mr. Roensch. A special cathode-ray oscillograph was developed for the work. One of the problems encountered was to damp out or reduce the fluctuations in the voltage of the laboratory supply circuit. By means of a balancing network these fluctuations in the plate and screen voltages were cut down from 10 per cent to less than 0.05 per cent, while the ripple was reduced to 0.001 per cent. At the maximum amplification of about 3,000,000, the diagram "floats" about ⅛ in. on the 5-in. screen (as a result of the remaining voltage fluctuations).

The cathode-ray oscillograph indicates or records alternating or oscillating currents produced in so-called pickup devices actuated by the member whose vibration it is desired to study,

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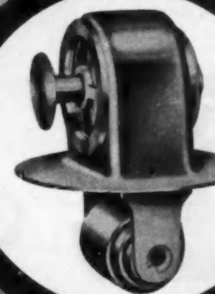

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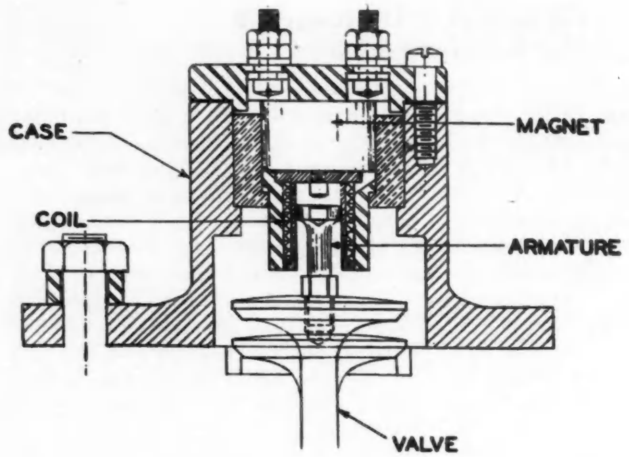


Fig. 1—(Left) "Valve gear" indicator

and the paper described two such pick-up devices, developed for the study of valve motion and of crankshaft torsional vibration respectively. A study of valve motion may be made necessary by noisy operation of an engine, and the authors said that if all other moving parts of an engine were removed and the camshaft and valve gear driven at 2000 r.p.m., and if an engineer were then led up to the engine blindfolded, his guess would be that the engine was running at 4000 r.p.m.

The "valve-gear" indicator is illustrated in Fig. 1. A small steel armature of 0.013 lb. weight is screwed into the valve and moves in a uniform magnetic field, changing the flux through the stationary winding and generating a voltage proportional to the velocity of the valve. By integrating this wave electrically, we obtain the lift curve, and by taking its derivative, the acceleration curve, the curves of Fig. 2 were ob-

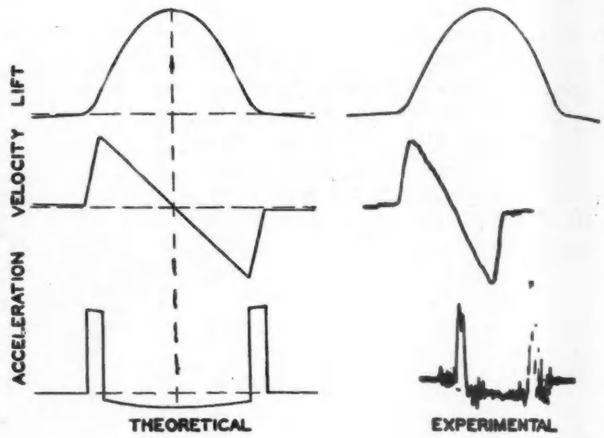
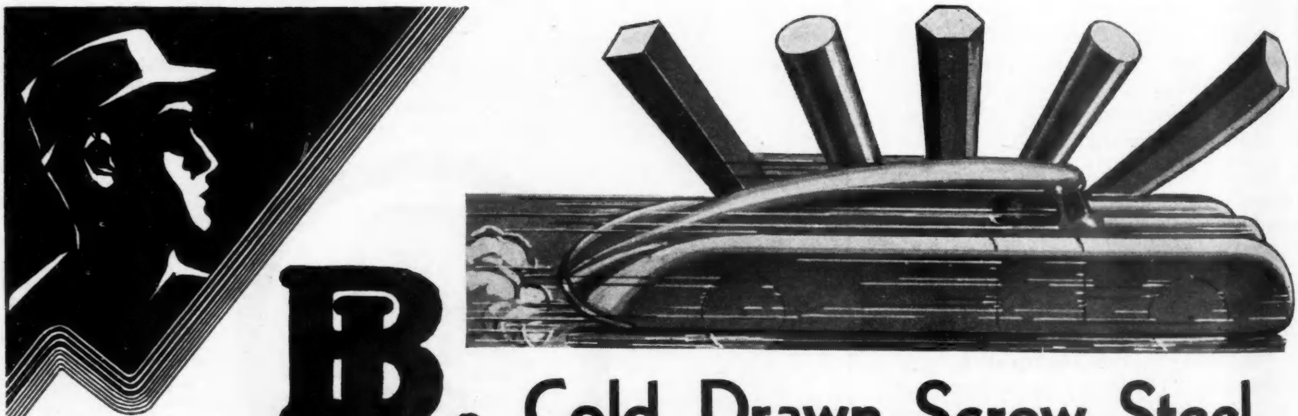


Fig. 2 — (Right) Valve motion speed and acceleration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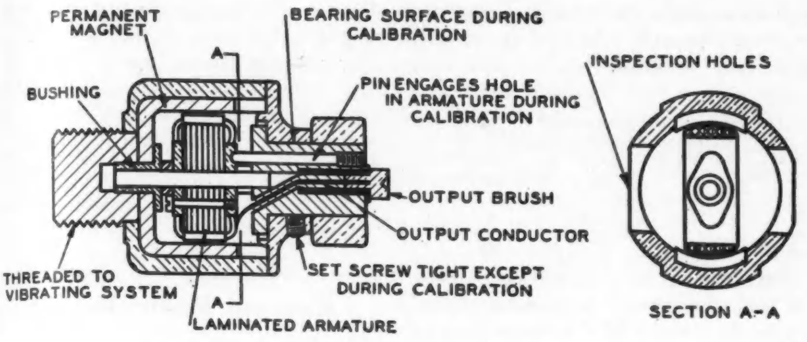
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Fig. 3—Torsional vibration pickup

tained. At 1800 r.p.m. of the camshaft, while the lift curve is smooth, the velocity (and particularly the acceleration) curve shows considerable departure from the curve based on calculated data. It is interesting to note that the disturbance created when the tappet clearance is being taken up and when the valve is seated is not as great as that due to suddenly applying the accelerating force.

By taking the curve at 300 r.p.m. of the camshaft it was expected to eliminate the effects of vibration, but the result again was a ragged curve, which can only be attributed to imperfections of the surface finish. At this speed and up to medium speeds the seating of the valve and the take-up of the tappet clearance were found to contribute most to the noise.

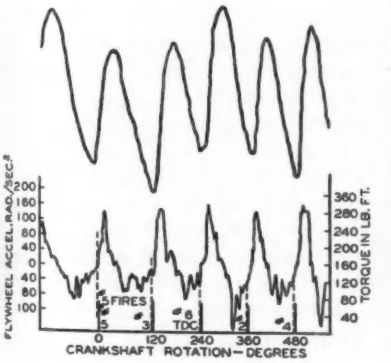
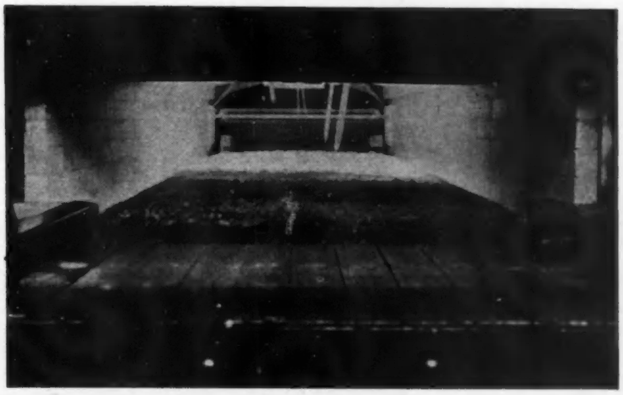


Fig. 4 — Velocity and torque cycles

The torsional-vibration indicator developed (Fig. 3) consists of a wound armature free to rotate between the two poles of a magnet. The pull of the magnet keeps the armature centered and gives it a torsional frequency of about 5 cycles per second, which permit its use above 600 r.p.m. The magnet turns with the vibrating shaft, while the armature rotates at constant speed, generating a voltage proportional to the velocity of the torsional vibration. The relation between the speed of the armature relative to the magnet and the oscillograph screen deflection is determined by rotating the instrument at a known speed while holding the armature stationary. The unit is of only 2-in. diameter, hence its effect on the vibrating characteristics of the system is negligible. At speeds above 500 r.p.m. the cyclic variation of the torque, when positive accelerates the rotating parts, the acceleration being the ratio of the instantaneous minus the mean torque, to the moment of inertia of the rotating parts.

The "derivative" of the card taken



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from the indicator is therefore a curve of the torque cycle. Both the original and the derivative curve are represented in Fig. 4. For a six-cylinder engine the ratio (maximum torque mean torque) was found to be 1.90, which is much higher than the theoretical value.

Harmonic analysis of the torque-cycle curve for various speeds showed the 12th and 15th harmonics to have the greatest amplitudes. The "strengths" of the harmonics of the gas-torque cycle (as represented by that corresponding to a speed of 1000 r.p.m.) are compared to the corresponding torsional-vibrating amplitudes (of a shaft having a natural torsional-vibration frequency of 274 cycles per second) in the following table.

R.P.M.	Order of Harmonic	Amplitude of Gas-Torque Harmonic	Torsional Amplitude
1100	15	23.5	0.075 deg.
1375	12	20.0	0.064 "
1840	9	13.1	0.113 "
2740	6	13.0	0.430 "

There will be seen to be fair correlation between the gas-torque harmonics and the amplitudes of the corresponding torsional vibration up to 1375 r.p.m.; beyond that speed the harmonics of the inertia cycle dominate. No torsion above 0.075 deg. would occur in this shaft under the influence of gas pressure alone, which indicates the importance of reducing the weight of reciprocating parts to hold down vibration due to inertia torque.

French Council Suggests General Research Tests

A LONG abstract of the general conclusions adopted by the French National Economic Council at a session devoted to a consideration of the automobile industry, and of a report on this subject made to the Council by M. Schwartz, chief engineer of roads and bridges, is printed in the February number of the *Journal of the French Society of Automobile Engineers.*

The National Economic Council makes the following suggestions to the automobile industry and trade:

All French manufacturers and foreign manufacturers operating in France should be called upon to participate in the establishment of a general laboratory for technical research on automobiles, engines, and fuels, and to contribute to its operation, the results obtained being the common property of all.

French manufacturers should organize and discipline themselves. Agreements should be entered into with a view to reducing the number of models in production, to prevent too frequent change of models, to standardize the types of raw materials used in automobile production and to confine orders to these; to leave to specialists the manufacture of certain parts, special bodies, items of equipment, and accessories. The constant aim should be to cut down production costs.

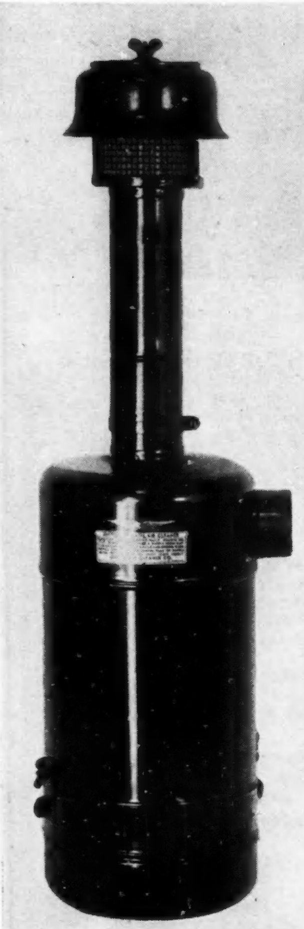
Simple, Inexpensive Automobiles

It is necessary that the French mass-production industry direct its efforts toward the production of a simple, robust and inexpensive automobile of a type which would appeal to rural buyers and to buyers in the colonies and in undeveloped countries generally.

The French automobile industry should create a central statistical bureau to compile statistics of its production; it should be open to the general statistical services of the nation and should, moreover, make a methodical study of the foreign markets open to the French automobile industry.

The automobile trade should be placed on a sounder basis by the establishment of an official system of appraising used cars, similar to systems

ANOTHER UNITED ACHIEVEMENT



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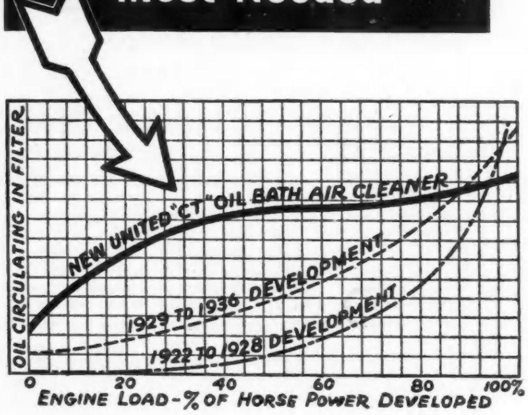

Most oil-circulating air cleaners perform efficiently above half throttle openings. The new United "CT" oil bath air cleaner shows same relative high cleaning efficiency at less than half loads as at three-fourths to full engine loads—already adopted as standard equipment on tractors and industrial power units of nationally known manufacturers.

Better engine protection is our constant aim.

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which have been introduced in several other countries.

The National Economic Council requests that the government second the efforts made by the automobile manufacturers by carrying out necessary road improvements, eliminating grade crossings on main lines, and investigating the advantages of special automobile highways from the standpoint of national defense, as they are not required for ordinary traffic.

Automobile regulations should be revised from time to time to take advantage of developments tending toward the reduction of road hazards, such as servo brakes, power steering gears, yellow headlamp bulbs, etc. Restrictions on the maximum dimensions of vehicles should be liberalized, and technical inspections should be required whenever a vehicle changes hands, and at intervals of five years or less in any case.

Physical Examination for Drivers

The medical examination which is called for before a license is issued to prospective truck and bus drivers, should be required also before a license is reissued to any driver who has been in an accident and has had his license suspended in consequence. Working conditions of drivers of commercial vehicles should be revised and should be subject to strict and efficient control. It is suggested that, as a tentative measure, operators' licenses or permits for motorcycles with engines of not over 10.67 cu. in. displacement be dispensed with; and if the measure proves successful it can be made permanent and possibly extended to machines with larger engine displacement. Road users should be educated by every available means, starting with the public schools (the press, the radio, etc.). Statistics of road accidents should be published annually, and a study should be made of the records of automobile-insurance companies with a view to arriving at the best measure to assure that victims of accidents be placed in position to collect the indemnities to which they are entitled. The problem of the coordination of the various means of transport should be reexamined.

It is suggested that the tax on motor fuels be reduced 50 per cent, and that the tariff schedule on automobile accessories be revised so as to include certain items which are now imported under other, less heavily assessed groupings. If the volume of imports should make it necessary, the duties on accessories should be increased. The government should encourage the search for and the use of new motor fuels. Remission of taxes on exported French cars should be regulated in accordance with national economic needs, and should be restricted to makes of French origin, to the exclusion of makes of foreign origin. Similar remissions might be granted on bodies, tires and certain items of equipment.

The Ministers of War and of Air should be requested to pass their orders to the automobile industry with the greatest possible regularity. The national government and the overseas colonial administrations should be asked to buy their automotive equipment only from manufacturers of national origin.

Under present conditions, manufacturers have no recourse against cheap imitations of parts of their products, and in view of the heavy losses they suffer in consequence, the subject should have the attention of the competent juridical authorities. A revision of the customs regulations of Morocco, the Congo-Niger Convention territory and of the French mandated territories would be of great interest to the French automobile industry.

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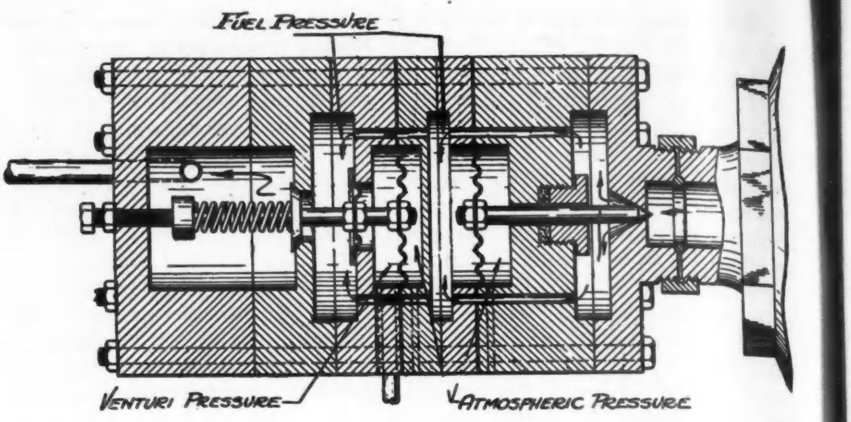
Gaseous Paraffines As Anti-knocks



Detailed drawing of the Thatcher fuel system

IT is well known that the members of the paraffine series of hydrocarbons immediately below hexane, that is, butane and propane, have good anti-knock qualities. Since these materials are in the gaseous state under normal atmospheric conditions, they may be introduced directly into the intake passage of an engine above the point of vaporization of the liquid fuel. The introduction of a limited quantity of this gaseous fuel into the intake pipe permits it to be immediately dispersed through the atomized fuel flowing through the pipe, with the result that when the fuel reaches the engine it contains a substantially uniform supply of anti-knock material. A patent on this system of operating internal combustion engines has been assigned to the Texas Company*.

Diaphragm valves are used in the system, operated by the pressure at the throat of the carburetor, to assure that the anti-knock gases are supplied only when the throttle is open and the engine is running at relatively low speed. The automatic valve system is designed to shut off the flow of anti-knock fuel when the engine is not running or is idling; to permit the gas to flow at a slow, controlled rate when the throttle is suddenly opened, and to shut off the flow as the engine attains a high speed. The anti-knock fuel is carried in liquid form in a steel bottle on the frame of the car and the control valve is connected directly to the neck of the bottle.

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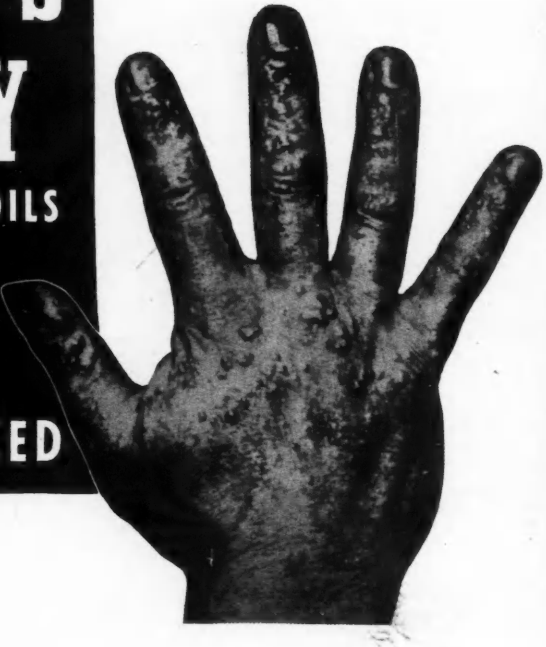
* Patent No. 2,050,978. Method of Introducing Anti-Knock Fuels Into Internal Combustion Engines. William N. Thatcher, North Tarrytown, N. Y.

Duro Construction for Bus Bodies

A DESIGN of all-metal all-welded bus body with steel framing incorporating what is referred to as inter-tied Duro construction, has been developed by the Rex-Watson Corporation of Canastota, N. Y., a firm that has been building composite bus bodies for a long time.

In the design of the new all-metal body, maximum strength and moderate weight were aimed at. The cross members which form the foundation of the body structure are welded and bolted to



HERE'S WHY CUTTING OILS MUST BE STERILIZED

IF your plant uses cutting lubricants, your men must be protected from Oil Dermatitis. Pus-forming germs, carried from worker to worker by infected cutting lubricant, can speedily slow down production and lower plant efficiency . . . can put your entire force under doctor's care.

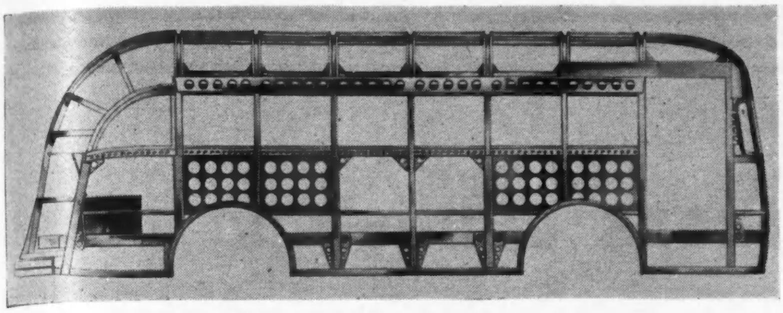
You can quickly end this menace by sterilizing all cutting lubricants with Derma-San. One pint of Derma-San poured into 35 gallons of lubricant, kills dangerous Oil Dermatis germs before they enter cuts in workers' hands and arms. For Derma-San is powerful—effective. Yet it is non-toxic, non-corrosive . . . does not irritate the skin.

Protect your men against the dangers of Oil Dermatitis by ordering a drum of Derma-San today. You'll find it the most dependable protection you can buy.

Derma-San is also ideal for all plant sanitation.

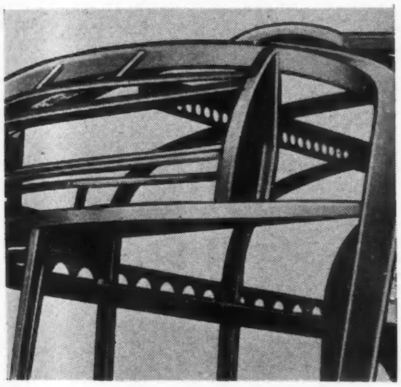
The HUNTINGTON LABORATORIES Inc.
DENVER HUNTINGTON, INDIANA TORONTO

DERMA-SAN
DISINFECTANT



All-steel welded frame of Rex-Watson transit bus

the chassis frame, thus making the chassis and body a single unit. Reinforcements are provided at door openings, windshield pillars, and the rear-window framing. Many of the frame members are perforated to save weight. Body sheets, which may be either of duralumin or steel, are riveted to the framework and thus add to the structural strength. The design is said to be such that maximum loading space is obtained without sacrifice of convenience or appearance.



Details of windshield header and corner post of Rex-Watson all-steel bus body

At the rear the bus is protected by a bumper of molded rubber mounted on an extension of the frame channels, and the ends of the bumper bars curve around and extend forward 20 in. on each side. Rub rails on the sides are reinforced by 2-in. duralumin channels.

In the design of the new bus, due consideration was given to the element of appearance, in recognition of its influence on the riding public. A full-width, non-reflecting windshield assures good vision. Roof and belt moldings extend along the sides; they sweep down in graceful lines at the rear and run together near the bottom at the rear. Tail lamps and signaling devices at the rear are either submerged in the body or else "streamlined."

This type of bus is built in capacities of from 21 to 35 passengers. The entrance door may be located either ahead of or behind the front-wheelhousing. The inter-tied Duro construction is to be applied also to school buses.

Improvements have been made also in the composite school-bus bodies of the company, which now have a steel sill that extends entirely around the body and is welded to the chassis outriggers, thus forming a rigid foundation to which the hardwood posts of the side framing are fastened by means of gussets. The posts are also gusseted to the steel roof rail.

DUB OR PRO?

YOU can't tell a "par-buster" by his clubs or duds. It's his swing that counts. Nor is appearance alone the means of breaking car sales records. The public still — always will — insist on definite proof of stamina and performance. Thus manufacturers are quick to refine those "hidden but vital" parts so directly responsible for smooth, economical, and dependable transportation. Consider, for example, CLUTCH RELEASE BEARING PROBLEMS. In rapid succession the big names of motordom have adopted dependable par-performing Aetna T Type Bearings because they end excessive wear, bothersome chatter, and costly repair bills caused by the ultimate failure of conventional type thrust bearings. Moreover, in Aetna T Type Bearings centrifugal and centripetal forces imprison the lubricant and confine it to the balls, eliminating greasy clutch facings and insuring silent, trouble-free action.

There's a sample Aetna T Type Bearing ready and waiting to stand-up under any test you might give it . . . write for yours today.

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Chilton strengthens publishing plan with 1937 no-waste advertising package

Motor World Wholesale, beginning with the issue of July, 1937, will be enlarged from pocket size to standard size, with the same 7″ x 10″ type page as Motor Age and Automobile Trade Journal.

Its circulation will be concentrated on the leading jobbers who do 85% of the dollar volume in the automotive wholesale field. Advertising space in Motor World Wholesale will be a plus service to advertisers in Motor Age or Automobile Trade Journal. A page in either of these publications will carry with it the privilege of a page without cost in Motor World Wholesale, and this same privilege goes with fractional pages, too.

This automotive advertising package, unmatched and unmatchable, is by all odds the best buy ever offered in this field.

There will be no immediate increase in the advertising rates of Motor Age or Automobile Trade Journal. Contracts at the present rates ($160 per page on a 12-time basis) will be accepted until further notice.

Ask for complete details.

CHILTON COMPANY

Chestnut and 56th Sts. Philadelphia, Pa.